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Evaluation of Motor Vehicle Emissions Inspection/Maintenance Programs for Michigan. Volume II

Pacific Environmental Services, Inc.
Santa Monica, CA

Prepared for

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16. ABSTRACT

The State of Michigan, pursuant to the Clean Air Act as amended (1977), is required to consider an Inspection/Maintenance (I/M) program for part or all the State because the five-county Detroit metropolitan area, at least, is expected to be unable to meet applicable air quality standards prior to the 1982 deadline. This study evaluates a range of possible I/M program configurations to assist in the identification of a short list of alternatives that would be appropriate in Michigan.

The findings of this study are presented in two volumes. Volume I explores a broad range of I/M options while Volume II performs a comprehensive evaluation of costs and benefits for a matrix of 24 program configurations differentiated by administrative mode, inspection procedure and scope. As a result of the comparative analysis, a short list of candidate options is proposed for further study. Volume I is an Executive Summary (EPA-905/2-79-003A).

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EVALUATION OF MOTOR VEHICLE EMISSIONS INSPECTION/MAINTENANCE PROGRAMS FOR MICHIGAN

VOLUME II

October, 1979

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Section 1

INTRODUCTION

Inspection/Maintenance (I/M) is a term used to denote the mandatory, periodic inspection of motor vehicles. The purpose of an I/M program is to identify vehicles whose emissions are in excess of acceptable levels. Such vehicles must be repaired or adjusted. An I/M program is intended to supplement the Federal Motor Vehicles Control Program which requires emissions control equipment on new vehicles.

As a result of the Clean Air Act Amendments of 1977, the State of Michigan must consider I/M programs for implementation. To assist the State in this evaluation, the U.S. Environmental Protection Agency (EPA), Region V, contracted Pacific Environmental Services, Inc. (PES) and Systems Control, Inc. (SCI) to provide the necessary technical analysis.

The analysis has been separated into two volumes. Volume 1 presents basic information about I/M and defines alternative administrative approaches and methods of test. U.S EPA requirements and other related topics are also discussed.

Volume 2 provides a detailed evaluation and comparison of the options defined in Volume 1, and is separated into seven sections:

Section 1 - Introduction - Presents background information.

Section 2 - Benefits - Discusses the benefits which result from the implementation of I/M.

Section 3 - I/M Program Requirements - Explains the principal elements of the I/M options.

Section 4 - Program Cost Elements and Methodology - Describes the cost model and cost elements used in the analysis.

Section 5 - Option Definition - Defines specific program benefits and costs for basic options, including such items as capital investments, operating costs, and consumer fees.

Section 6 - Comparative Analysis - Summarizes the other I/M options and discusses the cost-sensitivity of test modes, administrative approaches, geographic area of coverage, and other issues.

Section 7 - Issue Identification and Option Elimination - Provides the basis for elimination of some options and identifies options for further study.

1.1 OBJECTIVES/PURPOSE

The overall objective of an I/M program is to reduce vehicle emissions. The purpose of this study is to evaluate the alternative approaches and test methods for an I/M program and determine which one is best suited for application in Michigan. The cost of the various alternatives is one of the main factors determining the desirability of a program; however, other factors, such as effectiveness, benefits, and ease of implementation, will also be considered.

The Michigan Department of Transportation (MDOT) is responsible for providing the technical analysis of an I/M program to the state legislature. This study will provide the rationale behind the options chosen for further analysis and possible implementation.

1.2 BACKGROUND

The Clean Air Act Amendments of 1977 require attainment of the ambient air quality standards for carbon monoxide (CO) and ozone (O_3) by December 1982. If an area is unable to demonstrate attainment by that date, despite the implementation of all reasonable controls, an extension up to 1987 may be granted if the State meets certain requirements. One such requirement is the implementation of a vehicle emissions I/M program. The Clean Air Act also requires a State Implementation Plan (SIP) to explain how a State intends to meet the ambient air quality standards. The SIP must contain a schedule including I/M implementation milestone dates in order to be acceptable. These milestones are to ensure progress toward actual start-up of the program.

The Clean Air Act also requires that the State must have the legal authority to implement the programs it specifies in the SIP. This includes the legal authority to implement I/M. Since each state's SIP must have been approved by July 1, 1979 in order to avoid santions specified by the Act, EPA has stated that the legal authority to implement I/M must have existed by that date in order for the state to have an approvable SIP. Although the Clean Air Act does not specifically provide for an extension of the date for legal authority, EPA has issued policy guidance stating that a 1-year extension may be granted if a state has not had sufficient opportunity to complete the necessary technical analysis prior to considering I/M legislation. The required start-up date of the I/M program is December 31, 1981 for decentralized programs, and December 31, 1982 for centralized programs regardless of when legal authority is obtained. The State of Michigan will be seeking legal authority for I/M in September of 1979 based on the recommendations of this study.

The Clean Air Act does not specifically state what type of an I/M program the states must implement. That decision is made by the individual states. The EPA has issued policy guidance outlining what they consider to be a minimally acceptable I/M program, and this information was presented in Section 3 of the Task 1 report. Briefly, all I/M programs must provide for regular and periodic inspection of all vehicles for which emission reduction is claimed. Additional emission reductions can be obtained by including heavy-duty vehicles such as buses and trucks, but EPA does not require this inclusion. The program must require repair of failed vehicles and provide for adequate quality control. Other policy requirements are determined by the type of program a state chooses and pertain to recordkeeping and licensing of inspection stations. EPA has provided a method for calculating emission reductions for an I/M program which was also discussed in Section 3 of Task 1. These emission reduction esimates apply to either an idle or loaded exhaust emission test, but not to a parameter or device inspection approach.

There are two types of sanctions stated in the Clean Air Act. They include discretionary sanctions related to transportation and highway funding, state agency grants, and sewage treatment facility grants; and nondiscretionary sanctions relating to stationary source permits. The following sections taken from the Clean Air Act describe the sanctions:

Permits:

Sec. 110(a) (2) - "(I) it provides that after June 30, 1979, no major stationary source shall be constructed or modified in any nonattainment area (as defined in Section 171(2)) to which such plan applies, if the emissions from such facility will cause or contribute to concentrations of any pollutant for which a national ambient air quality standard is exceeded in such area, unless, as of the time of application for a permit for such construction or modification, such plan meets the requirements of part D (relating to nonattainment areas);..."

Transportation and State Agency Grants:

"Sec. 176. (a) The Administrator shall not approve any projects or award any grants authorized by this Act and the Secretary of Transportation shall not approve any projects or award any grants under title 23, United States Code, other than for safety, mass transit, or transportation improvement projects related to air quality improvement or maintenance, in any air quality control region--

"(1) in which any primary ambient air quality standard has not been attained,

"(2) where transportation control measures are necessary for the attainment of such standard, and

"(3) where the Administrator finds after July 1, 1979, that the Governor has not submitted an implementation plan which considers each of the elements required by Section 172 or that reasonable efforts toward submitting such an implementation plan are not being made or, after July 1, 1982, in the case of an implementation plan revision required under Section 172 to be submitted before July 1, 1982."

Sewage Treatment Grants:

Section 316 (b) - "The administrator may withhold, condition, or restrict the making of any grant for construction...(of sewage treatment works)...if he determines that...(2) the state does not have in effect, or is not carrying out, a State Implementation Plan approved by the Administrator..."

If a state's SIP is not approved, the nondiscretionary sanctions will become effective after July 1, 1979. The other discretionary sanctions will become effective if the EPA administrator determines that a state is not making progress toward submitting or complying with a SIP. Sewage treatment grants are subject to restriction because increased sewage treatment capacity is directly related to industrial, residential, and commercial growth. All of the Clean Air Act sanctions are tied to approval of or compliance with the applicable SIP.

Recent ambient air quality data gathered by the Michigan Department of Natural Resources (MDNR) indicate the O_3 and CO concentrations in certain areas of the State exceed levels prescribed by the National Ambient Air Quality Standards (NAAQS). These nonattainment areas are shown in Figure 1-1. Since the Detroit metropolitan area is not expected to attain the standards until after the 1982 deadline, the State of Michigan must implement an I/M program in the Detroit area to avoid Clean Air Act sanctions. Other metropolitan areas in the State are expected to attain the standards by 1982.

As a part of this study, the administrative approaches and methods of test discussed in Task 1 will be evaluated. In addition, other geographic areas will be considered for inclusion in the program, and the following questions will be discussed:

1. Which option is most desirable for area implementation?

2. Are the various scenarios technically feasible using current technology, instrumentation, and technical personnel?

3. What are the costs to the State and to the vehicle owner?

4. What degree of participation will the State and private industry have in the management, ownership, and operation of statewide facilities for various options?

5. What has been the reaction of the general public in mandatory inspection programs in other states?

6. What benefits will the State and the public realize from this program?

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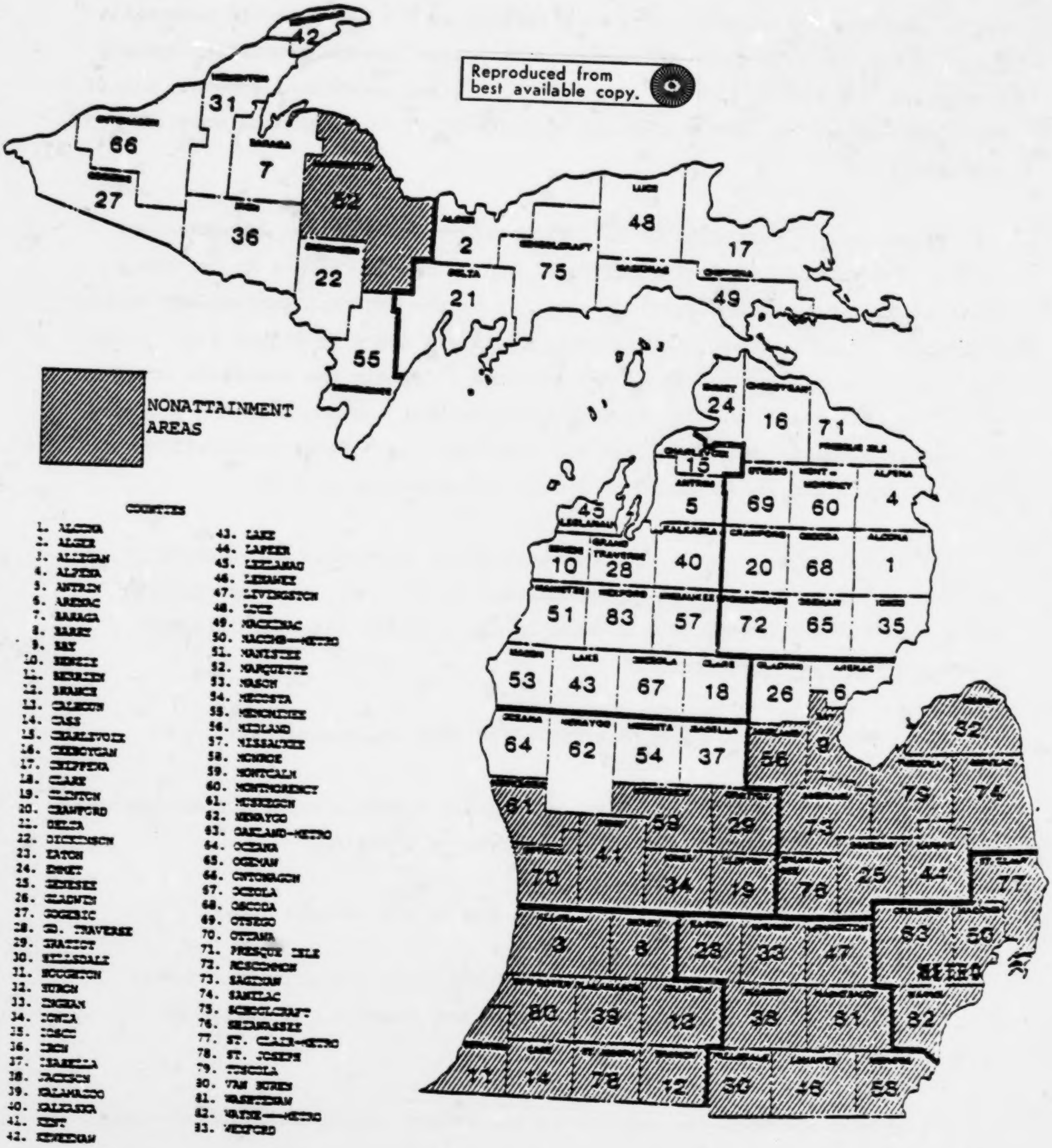
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58. MONROE
59. MONTCALM
60. MONTMORENCY
61. MUSKEGON
62. NEWAYGO
63. OAKLAND—METRO
64. OCEANA
65. OGEMAW
66. ONTONAGON
67. OSCEOLA
68. OSCODA
69. OTSEGO
70. OTTAWA
71. PRESQUE ISLE
72. ROSCOMMON
73. SAGINAW
74. SANILAC
75. SCHOOLCRAFT
76. SHIAWASSEE
77. ST. CLAIR—METRO
78. ST. JOSEPH
79. TUSCOLA
80. VAN BUREN
81. WASHTENAW
82. WAYNE—METRO
83. WEXFORD
42
31
66
7
27
52
36
48
2
17
75
22
21
49
55
24
16
71
PRESQUE ISLE
15
45
LEELANAU
5
69
60
4
ALPENA
10
28
GRAND TRAVERSE
40
20
68
1
51
83
57
72
65
35
53
43
LAKE
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18
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6
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74
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19
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77
3
8
23
33
47
63
50
METRO
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13
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81
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78
12
30
46
58

Figure 1-1. Michigan Ozone Nonattainment Counties

Briefly stated, this study evaluates the technical feasibility of various I/M programs, identifies and quantifies program costs, describes total program benefits, and defines candidate options for further study.

1.3 STUDY REQUIREMENTS

One of the requirements of this evaluation is to discuss each of the identified program options in terms of various issues and criteria. Each of the following issues requires analysis, and many of these issues will be the subject of programmatic decisions that must be made during the planning process. The most significant decisions surround the administrative approach and method of test, but decisions relating to the other issues may mean the difference between acceptance or rejection of the program by the general public. The major issues and criteria used in the evaluation are as follows:

1. Alternative administrative approaches and test methods (Table 1-1)

2. Vehicle categories subject to inspection and maintenance (I/M)
    a. Light-duty vehicles (< 6,001 pounds): LDV and LDT_1
    b. Medium-duty vehicles (6,001 to 8,500 pounds): LDT_2
    c. Heavy-duty (> 8,500 pounds) gasoline vehicles: HDGV
    d. Heavy-duty (> 8,500 pounds) diesel vehicles: HDDV
    e. Motorcycles: (M/C)

3. Geographic area of applicability
    a. Statewide (83 counties)
    b. Nonattainment counties (38 counties)
    c. Nonattainment regions
        Grand Rapids (Ottawa and Kent)
        Lansing (Clinton, Eaton, and Ingham)
        Flint (Genesee)
        Detroit (Macomb, Monroe, Oakland, Washtenaw, and Wayne)

Table 1-1. ADMINISTRATIVE APPROACH VERSUS METHOD OF TEST

Administrative Approach	Method of Test		
	Idle	Loaded	Parameter/ Device Inspection
State-operated	*With safety and noise	With safety and noise	With safety and noise
	*Without safety and noise	*Without safety and noise	*Without safety and noise
Contractor-operated	With safety and noise	With safety and noise	With safety and noise
	*Without safety and noise	Without safety and noise	Without safety and noise
Private-garage	With safety and noise	With safety and noise	With safety and noise
	*Without safety and noise	Without safety and noise	Without safety and noise
Statistical sampling	With safety and noise	With safety and noise	With safety and noise
	*Without safety and noise	Without safety and noise	Without safety and noise

*Base option

4. Program benefits
    a. Expected reduction in emissions
    b. Fuel savings
    c. Effect on vehicle performance and life
    d. Value of warranty repairs performed
    e. Employment generation and other economic growth effects
    f. Offsets and emission "banking"
    g. Intangible benefits

5. Program cost analyses
    a. Initial implementation and capital costs
    b. Annual operating costs
    c. Ancillary programs annual operating costs

6. Costs and benefits of I/M program options

7. Consumer protection and mechanic's training

8. Public information program

9. Legislative requirements and state agency roles

Note that in Table 1-1, both safety and noise testing are included as auxilliary programs under method of test. Although safety and noise testing are not required elements of an emissions testing program in the Clean Air Act, another requirement of this study is to evaluate these auxiliary programs for possible inclusion. None of these programs is being considered as an individual program for implementation.

1.4 STUDY COST AND METHODOLOGY

A unit cost concept was used in the cost analysis of the options. The units used are one and two lane test stations. The number of one and two lane stations is determined by the vehicle population of the geographic areas. The station operating and capital costs are estimated by direct multiplication of the unit cost times the number of stations.

Only seven of the 24 major program options listed in Table 1-1, are unique. These unique options are noted on the table. The other 17 options are combinations of elements of the seven unique options. For this reason, only the seven basic option costs are studied in detailed in Section 5; others are summarized in Section 6 for comparison. In Section 6, sensitivity factors have been developed and applied to the base options to generate the approximate program costs of the 17 nonbase options. For example, the sensitivity factor multiplied by the cost of a base option will determine if one of the nonbase options is more or less costly than the base option, without going into the detailed description of the base options. All of the costs are presented in 1978 dollars. Actual costs and fees will depend on the inflation rate and the year of program start-up. A detailed discussion of the program costing analysis is provided in Section 4.

Section 2

PROGRAM BENEFITS

The primary purpose and principal benefit of an I/M program is the reduction of vehicular emissions. However, there are associated benefits implicit in a successful I/M program that are reflected in monetary savings and improved driveability for the individual, and growth in employment for society at large. The magnitude of these associated benefits is generally - but not uniformly - a function of program content and coverage.

In the discussion which follows, those I/M program benefits that can be quantified for the State of Michigan at this stage of analysis will be assigned a numerical value. Those which cannot will be discussed in qualitative terms. Where the magnitude of a given benefit is sensitive to test mode or coverage, the variation will be noted.

2.1 EMISSION REDUCTION BENEFITS

The extent to which an inspection/maintenance program reduces the emissions from motor vehicles depends upon the specific features incorporated into the program. Appendix N of 40CFR Part 51 (May 2, 1977) lists the emission reduction expected utilizing I/M options. Emission reduction benefits resulting from I/M programs can also be calculated using the MOBILE 1 program developed by EPA. The State of Michigan, in cooperation with the Southeastern Michigan Council of Governments, has determined emission reductions that would result from an I/M program for light-duty vehicles less than 8,500 lbs gross vehicle weight instituted in the State's five nonattainment metropolitan areas. These results occur by assuming a 20 percent stringency factor (failure rate) and training for mechanics repairing vehicles under the program. Total expected emission reductions for light-duty vehicles are shown in Table 2-1. The totals shown are cumulative over the entire vehicle stream, but per-vehicle emissions would be reduced only for those units that have undergone repair following an inspection failure.

Table 2-1. INSPECTION/MAINTENANCE PROGRAM RESULTS IN MAJOR URBAN AREAS IN THE DESIGNATED NONATTAINMENT REGION

		Detroit*	Flint	Lansing	Grand Rapids	Niles
CO						
1982:	No I/M	3,885,672	168,420	135,129	182,651	9,557
	I/M 1 year	3,512,449	146,679	117,530	158,860	8,305
	% Decrease	9.6	12.9	13.0	13.0	13.1
1987:	No I/M	2,346,511	92,333	78,492	101,874	5,514
	I/M 5 years	1,746,443	58,196	49,401	64,085	3,433
	% Decrease	25.6	37.0	37.0	37.0	37.7
HC						
1982:	No I/M	352,863	20,527	17,135	21,087	1,066
	I/M 1 year	340,469	19,680	16,449	20,166	1,017
	% Decrease	3.5	4.1	4.0	4.4	4.6
1987:	No I/M	204,066	10,868	9,424	11,648	622
	I/M 5 years	159,350	7,882	6,883	8,349	439
	% Decrease	21.9	27.5	27.0	28.3	29.4
Figures are kilograms per average-summer-day for 20 percent failure rate not including mechanics training						

*Values supplied by Southeastern Michigan Council of Governments. Hydrocarbon totals for Detroit include only reactive HC.

Note: I/M program presumed to include 20 percent failure rate (stringency factor) and repairs by trained mechanics.

If an I/M program were to be expanded to cover the entire 37-county nonattainment region, or the state as a whole, percentage emission reductions would be similar to those indicated for the Niles (Berrien County) urbanized areas because of the similarities in vehicle characteristics and travel. Obviously, the actual reduction in emission intensity or weight would be considerably less for each county outside the metropolitan areas because of lighter travel densities and fewer incidences of congestion which decreases travel speed, and in turn increases per-vehicle emissions.

Additional program benefits may be obtained if heavy-duty gasoline-powered vehicle inspections are included. U.S. EPA has established revised emission standards for heavy-duty (greater than 8,500 lbs gross vehicle weight) gasoline vehicles, and they are investigating the recommendation of test standards for these vehicles.

There are two cogent arguments for including heavy-duty gasoline powered vehicles in an I/M program. The first is that, in the average speed range common to most metropolitan areas, heavy gasoline vehicles emit three to four times as much pollutant per unit distance traveled as automobiles and light trucks. This fact is attributable both to the higher base emission characteristics of heavy gas vehicles and to the usual case of an older, "dirtier" vehicle mix among heavy trucks in the traffic stream. The second argument is that the frequent utilization of heavy gas trucks in cartage, construction, and other high-use operations makes the annual total miles of operation comparable to annual miles of travel by light-duty vehicles and simultaneously contributes to more rapid emission deterioration. Consequently, although heavy gasoline trucks are believed to account for less than 5 percent of total vehicle miles of travel nationwide, they may contribute up to 15 percent of total vehicular emissions of HC and CO.

Emissions from diesel-powered vehicles (though occasionally characterized by visible smoke, strong odor, and aesthetic unpleasantness) are relatively low in HC and CO, and thus, EPA estimates.account for a minimal contribution (about one percent) to mobile-source related ozone and carbon monoxide air pollution.

Some existing I/M programs do include the testing of heavy-duty diesel trucks. However, the test performed on these vehicles does not monitor emissions of HC and CO, but checks only the density (opacity) of smoke issuing from the exhaust stack. If Michigan opted to test these vehicles, equipment requirements for vehicle inspection stations would include opacity meters and other specialty equipment for diesel testing. Also, because the test procedure is different, throughput and hence station efficiency would be affected.

2.2 FUEL SAVINGS

It is generally accepted that the fuel economy of any automobile will be improved with proper maintenance, especially tune-up. The I/M program tends to isolate those vehicles which are gross emitters and thus, by inference, badly out of tune. Those vehicles that cannot comply with stringency standards and have deficiencies corrected either by getting a tune-up or by undergoing a minor adjustment to the carburetor will experience better fuel economy, thereby conserving energy resources.

Two studies that have been identified as establishing fairly reliable estimates of fuel savings attributable to an I/M program are those conducted during the mandatory State of California program at the Riverside testing facility[1] and during the ongoing testing program in Portland, Oregon.[2] The realiability of these studies is predicated on (1) the sample size and composition of vehicles followed through the study, and (2) the inclusion of catalyst-equipped (post-1974) vehicles. The California study found that, for vehicles of known pretest fuel economy which had failed inspection, been repaired, passed a second inspection, and were monitored for mileage under driving conditions similar to those before the first test, an average improvement in fuel economy of 2.7 percent among catalyst vehicles and 3.8 percent among noncatalyst vehicles was recorded. By contrast, the Portland results are proving to be much more conservative. The magnitude of mileage improvement appears to be more senstitive to the availability of trained mechanics for performing necessary repairs and to the type of driving undertaken than to present emissions control technology of individual vehicles. Table 2-2 presents the observed and hypothetical difference in fuel economy for repaired automobiles in pre- and post-catalyst age groups under a variety of circumstances.

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[1] State of California, "Evaluation of Mandatory Vehicle Inspection and Maintenance Programs," Unpublished report, December 1976

[2] United States Environmental Protection Agency, "Portland Study Interim Analysis: Observations on Six Months of Vehicle Operation," Unpublished report, January 1979

Table 2-2. FUEL ECONOMY RESULTS FOR REPAIRED AUTOS

Control Technology (Age Group)	Post-Repair Percent Improvement in Fuel Economy for			
	City Driving	Highway Driving	Untrained Repairs	Skilled Mechanic Repairs
Pre-Catalyst (1972-74)	+1.5	-0.7	1.0	+3.0
Catalyst (1975-80)	+1.0	-1.5	0	+3.0
3-Way Catalyst (1981-	---	---	---	+10.0-20.0*

*Hypothetical value based on presumption of additional diagnostic information on-board 3-way catalyst cars and on preview of rich failure modes of prototype engines.

These somewhat discouraging results for existing vehicles apply only to that proportion of the vehicle fleet that fails an emission test and is actually repaired. Therefore, a +3.0 percent value in Table 2-2 corresponds to a +0.6 percent value fleetwide if the I/M program stringency (failure rate) is 20 percent. The optimistic projection for fuel economy improvements to future technology vehicles is based on an assumption of improved test diagnosis (discussed below) and would correspond to a +2.0 percent improvement fleetwide.

The availability of skilled mechanics to repair failed vehicles appears to be critical to the ability of an I/M program to improve aggregate fuel economy. Under present laws, or after an appropriate training program, the State of Michigan would likely have an adequate supply of such mechanics. This will be especially important in future years when the technology of vehicle emission control incorporates the three-way catalyst system, which continually monitors and controls combustion temperature as well as carbon monoxide and unburned hydrocarbons in the engine exhaust. If vehicles equipped with three-way catalysts also include system feedback information readouts on the control panel, it should be possible for a skilled mechanic to diagnose the reason(s) for emission control failure at any engine operation speed, and therefore, to make the correct repair almost without error on the first attempt. Moreover, inspection diagnosis itself should be improved (i.e., test technicians' "truth charts" may be made more precise.) In summary, EPA has hypothesized that I/M programs will result in a significantly greater proportion of post-1980 model vehicles operating to manufacturers' specifications in regular travel than is the case for the present vehicle stream.

It should be pointed out that many other variables can influence fuel economy. These variables include the diagnostic capabilities of the test mode, characteristics of the vehicle population tested, and geographic coverage of the program, as well as the time the program has been in effect.

An estimate of fuel savings in 1978 dollars for failed light-duty vehicles resulting from I/M implementation in the 37 nonattainment counties in Michigan can be calculated for 1987. Assumptions include: 20 percent stringency factor; repairs by trained mechanics; daily total of 147,389,119 vehicle miles of travel; an average improvement of fuel economy for failed vehicles of 3.0 percent for pre-1981 and 10.0 percent for 1981 and later vehicles; an average fleet mileage figure of 25.0 mpg; and a cost of $0.73 per gallon of gasoline. The total projected vehicle miles of travel by county in Michigan was provided by the Michigan

Department of Transportation (see Table 2-3). Average fleet mileage is computed from a weighted mean of EPA mileage-per-gallon specifications for model-year light-duty fleets through 1987 (see Tables 2-4 and 2-5).

Table 2-3. ESTIMATED DAILY VEHICLE MILES OF TRAVEL (VMT) 1987 BY LIGHT-DUTY VEHICLES BY STUDY AREA*

Designated Study Area	VMT
Grand Rapids (Ottawa & Kent)	9,618,344
Lansing (Clinton, Eaton & Ingham)	6,510,039
Flint (Genessee)	8,647,615
Detroit (Macomb, Monroe, Oakland, Washtenaw & Wayne)	75,908,539
Nonattainment 37 Counties	147,489,119
Statewide (83 Counties)	171,195,471

*Source: Michigan Department of Transportation

Table 2-4. TRAVEL WEIGHTING FACTOR CALCULATION FOR LDV

Year	Vehicle Age	(a) Fraction Total Reg. For Michigan Vehicles	(b) Average Annual Miles Driven**	(a) x (b)	[(a) x (b)/sum] = Travel Fraction
1987	1	0.127	15,900	2,019.3	0.167
1986	2	0.124	15,000	1,860.0	0.154
1985	3	0.116	14,000	1,624.0	0.135
1984	4	0.113	13,100	1,480.3	0.123
1983	5	0.105	12,200	1,281.0	0.106
1982	6	0.092	11,300	1,039.6	0.086
1981	7	0.081	10,300	834.3	0.069
1980	8	0.072	9,400	676.8	0.056
1979	9	0.058	8,500	493.0	0.041
1978	10	0.043	7,600	326.8	0.027
1977	11	0.028	6,700	187.6	0.016
1976	12	0.017	6,600	112.2	0.009
Pre-76	13+	0.024	5,491	131.78	0.011

**Source: U.S. EPA Nationwide Estimates

Table 2-5. U.S. EPA MPG SPECIFICATIONS FOR LDV'S AND AVERAGE FLEET MILEAGE FOR LDV'S COVERED BY I/M BY 1988

Model Year	EPA Mileage Standard	Travel Fraction	$\frac{\text{Column (1)} \times \text{Column (3)}}{0.880^{b}}$
1987	27.5	0.057[a]	1.781
1986	27.5	0.154	4.813
1985	27.5	0.135	4.219
1984	27	0.123	3.774
1983	26	0.106	3.132
1982	24	0.086	2.345
1981	22	0.069	1.725
1980	20	0.056	1.273
1979	19	0.041	0.885
1978	18	0.027	0.552
1977	17.5	0.016	0.318
1976	16.8	0.009	0.172
1981-			26.266
1976-1980			18.899
TOTAL			24.989 Fleet Mileage

[a] Approximation based on estimated miles of travel accumulated by model year 1987 LDV's inspected by January 1, 1988. It is assumed that 30 percent of total registered 1987 model year cars will have been tested by that date.

[b] Normalization factor to reflect nonparticipation of pre-1976 vehicles and 70 percent of 1987 model year fleet.

The fleet mileage average from Table 2-5 has been disaggregated into averages for pre-1981 and three-way catalyst technology vehicles, respectively, in order to compute total daily fuel savings in 1987. It is assumed that failed vehicles are operating at either 3 or 10 percent below their model-specific EPA mileage ratings, and that failures will occur uniformly across the spectrum of all models (test cutpoints). Repair is therefore assumed to restore each vehicle to its "new car" mileage, represented in the aggregate by the appropriate average fleet mileage. Exceptions are in those cases where a vehicle fails a second emissions test and may or may not be exempted from further testing. It is conservatively estimated that vehicles failing twice constitute 20 percent of the original failures, and that no fuel savings can be credited to them. Travel affected by I/M improvements under a 20 percent test stringency is therefore; 0.2 -0.2(0.2) = 0.2-0.04 = 0.160, 16.0 percent of total vehicle miles.

Let this 16 percent value be called IMT_i for every geographic area of interest i. In each case it is equal to 0.16 times the daily VMT value in Table 2-3. The equation applied for fuel savings is

$$\Delta G = \left(\frac{(1.1\ \mathrm{IMT}_i)\ (\mathrm{TF2})}{\mathrm{MPG2}} - \frac{\mathrm{IMT}_i\ (\mathrm{TF2})}{\mathrm{MPG2}}\right) + \left(\frac{(1.03\ \mathrm{IMT}_i)\ (\mathrm{TF1})}{\mathrm{MPG1}} - \frac{\mathrm{IMT}_i\ (\mathrm{TF1})}{\mathrm{MPG1}}\right)$$

$$= \frac{.0731\ (\mathrm{IMT}_i)}{26.27} + \frac{.00447\ (\mathrm{IMT}_i)}{18.90}$$

where ΔG = gallons of fuel saved,

$$\left.\begin{array}{l} \mathrm{TF1} = 0.149 = \text{Travel fraction by pre-1981 LDVs in 1987} \\ \mathrm{TF2} = 0.731 \quad \text{Travel fraction by post-1980 LDVs in 1987} \end{array}\right\} \text{See Table 2-5}$$

$$\left.\begin{array}{l} \mathrm{MPG1}=18.90 \\ \mathrm{MPG2}=26.27 \end{array}\right\} \text{See Table 2-5}$$

1.1, 1.03 represent fuel savings multipliers. (10 percent and 3 percent improvement, respectively)

Table 2-6 presents the estimated daily fuel savings in gallons and 1978 dollars for each geographic area of interest in 1987. The estimates do not account for gasoline used to drive to the inspection station and wait for an inspection. Obviously, should the technological innovations on board three-way catalyst-equipped vehicles fail to conform to EPA expectations, the results for post-1980 vehicles may or may not be accurately represented.

From Table 2-6, total fuel savings in the nonattainment counties for the year 1987 could be as high as 26.0 million gallons, or $19.0 million. A statewide program could produce savings of 30.2 million gallons, or $22.0 million.

Table 2-6. FUEL SAVED DAILY BY AREA OF COVERAGE IN 1987,
IN GALLONS AND DOLLARS,
ATTRIBUTABLE TO AN I/M PROGRAM IN MICHIGAN

Area From Table 2-3	Gallons	1978 Dollars (73¢/gallon av. price)
Detroit (5-County Metro)	36,669	$26,768
Flint (Genesee)	4,178	$ 3,050
Grand Rapids (Ottawa, Kent)	4,646	$ 3,392
Lansing (Clinton, Eaton, Ingham)	3,145	$ 2,296
Nonattainment Counties	71,300	$52,049
(Less the above)	22,662	$16,543
Statewide	82,700	$62,025
(Less the above)	11,400	$ 9,976

2.3 EFFECT ON VEHICLE PERFORMANCE AND LIFE

Another possible benefit of an I/M program that accrues directly to motorists could be improvement of vehicle performance and increase of vehicle life. The impact of I/M on these factors is difficult to quantify, and studies to date have not been conclusive. They have centered on the way I/M affects vehicle deterioration rates. A deterioration curve (Figure 2-1) illustrates the rate at which a vehicle deteriorates after it has been tuned. This directly influences vehicle performance. To the extent that I/M slows the rate of change in the shortcurve, it should have a positive impact on vehicle performance. If an engine continues to operate within the manufacturer's specification due to I/M, it should perform at a higher level.

Improvement in performance and longevity resulting from I/M's impact on long run deterioration is unknown. It seems reasonable that a properly maintained vehicle will experience less wear than if it is not maintained to manufacturer's specifications. Assuming this relationship is true, I/M should have a positive effect on vehicle life.

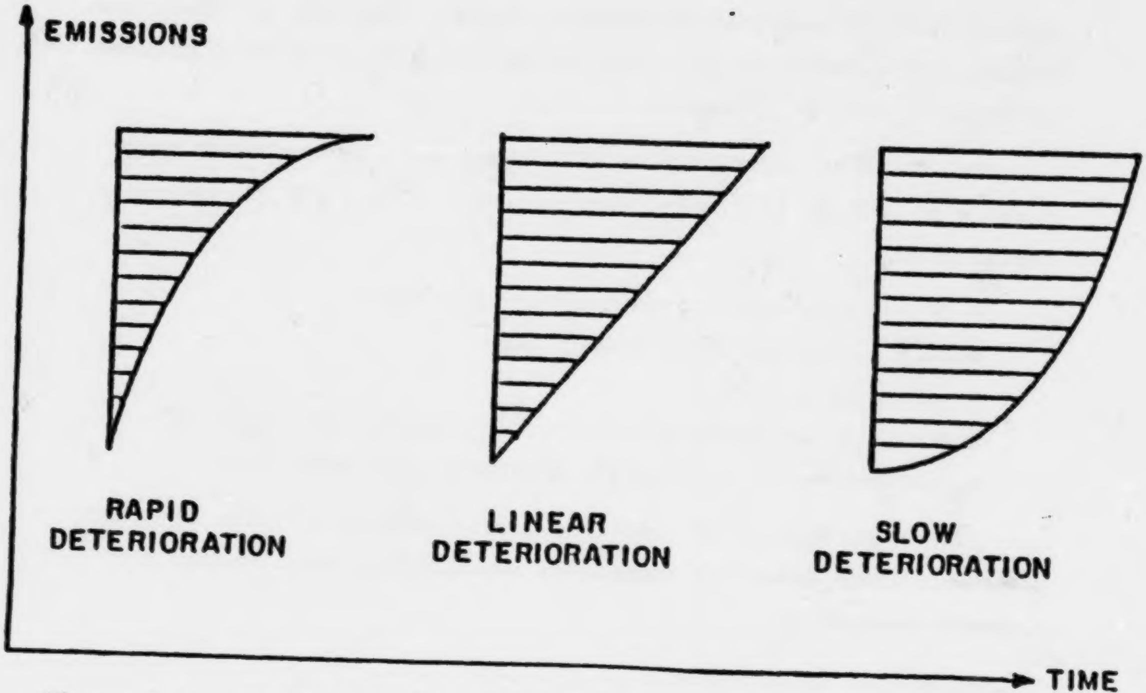
EMISSIONS
RAPID DETERIORATION
LINEAR DETERIORATION
SLOW DETERIORATION
TIME

Figure 2-1. Possible Post-Maintenance Deterioration Functions-Short Run

2.4 VALUE OF WARRANTY REPAIRS PERFORMED

Section 207 of the Clean Air Act mandates a new vehicle and engine emissions warranty which includes a general defects warranty in Section 207(a), a performance warranty in 207(b), and an enforcement and recall provision in 207(c). EPA has proposed regulations under Section 207(b) that will require every automobile manufacturer to bear the cost of repair of any properly maintained and operated vehicle that it has produced and which fails an EPA-certified emission test within 24 months or 24,000 miles, whichever comes first. After this period, the warranty applies only to catalytic converters, thermal reactors, or other components installed on or in a vehicle for the sole or primary purpose of reducing vehicle emissions.

The State of California in 1977 completed a surveillance test program on 1975 to 1976 model-year vehicles. These vehicles were tested using:

- CVS-75 test used in new car certification
- Federal highway fuel economy test
- Loaded-mode test
- Acceleration/deceleration driving sequence EPA model test
- Sealed housing evaporative determination (SHED) test

Only 9 percent of the vehicles failed because of defective components. These defective components may not have been covered by warranty because of:

- Lack of maintenance
- Abuse of vehicle
- Other unspecified reasons

It is evident that the subject of repair work to be performed under Section 207(a) warranty requires further study and definition to form a basis for analysis.

It was estimated that approximately 4 percent of the less than 24,000 miles of light-duty vehicles had defective parts prior to testing and would require warranty parts replacement. Based on existing registration data, vehicles with 24,000 miles or less on the odometer and subject to I/M account for approximately 11.3 percent of passenger cars.

The average cost of a warranty parts replacement would be approximately $32 in 1978 dollars. The light-duty vehicle population is projected to be 4,967,970 in 1983 for the nonattainment areas only. If 4 percent of the under-24,000 mile subject LDVs represented in this total (about 0.45 percent of total registration) undergo repairs to emission control components covered by warranty at an average repair cost of $32, the net additional value of warranty repair work performed on vehicles as a direct result of failures diagnosed during emissions inspection could approach $718,600 in 1983.

2.5 EMPLOYMENT GENERATION AND OTHER ECONOMIC GROWTH EFFECTS

Although the public demand generated by an I/M program is not truly an expression of genuine desire for a new good or service, this demand must in part be met by growth and/or transition in the private sector. Chiefly, the supply of trained mechanics and vehicle inpsection technicians will increase to meet this demand.

The total requirement for new positions in these two employment categories will be determined by the mode of test selected and the geographic coverage of the testing program. Staffing needs at test stations generally increase as a function of the diagnostic capabilities of the inspection test mode, which also governs the amount of time required per test. The requirement for repair mechanics is not sensitive to test mode unless private garages perform both inspection and repair. In this case, a lower proportion of each mechanic's labor time would be devoted to repair and thus the total mechanic requirement would increase as a direct function of the duration of an inspection. However, assuming a uniform level of capability, the overall demand for trained mechanic services may actually decline as test diagnostics improve. Obviously, total needs in both categories will increase as more counties are subject to the I/M requirement.

In practice, neither technicians nor trained mechanics are imported by test operators from outside a region subject to testing. It is conceivable that all new demand in these categories could be met by Michigan residents. In the case of a program operated by a contractor or through Michigan's private garages, all new employment generated by the demand for technicians and mechanics would be in the private sector. Technicians could be full- or part-time employees, depending on the testing load in a particular area or time of year. Most administrative and quality control functions required of State government under such a program optimally could be carried out by current state personnel. However, it is assumed that some augmentation of the State-employed work force will be necessary. New mechanics would be trained and present mechanics retrained through state and/or private programs. In the case of a program operated by the State itself, demand for mechanics would still be met in the private sector, but test technicians would probably have to be full-time state employees, with virtually all program operations employment generated in the public sector.

Specific estimates of the personnel requirements for each I/M program option are presented in Section 5 of this report. It is well to note that the total cost of this manpower would be met by a transfer payment within or between sectors and does not constitute true growth in gross state product. However, demand for hard goods in the classifications listed below is likely to increase after program implementation, resulting in revenue growth and possible employment expansion for Michigan manufacturers of these goods.

- Automotive repair parts
- Mechanics' hand tools
- Electronic analyzers (vehicle tuning)
- Garage accessories (e.g., hydraulic lifts, dynamometers)
- "Do-it-yourself" repair manuals

- Office equipment (testing and quality control stations)
- Industrial gases (used in test calibration)
- Building supplies and construction materials (test facilities)
- Uniforms; coveralls
- Software and other data processing supplies

This list could be augmented (or diminished) as the technology of the internal combustion engine and its emissions control systems evolves during the life of an I/M program.

2.6 OFFSETS AND EMISSION "BANKING"

Pursuant to Section 173 (1)(A) of the Clean Air Act, EPA issued its Emission Offset Interpretive Ruling, which requires that, until such time as a state issues its own permit regulations for new stationary emission sources consistent with the mandates of Section 172 of the Act, any new source in a nonattainment area must meet the "....lowest achievable emission rate for the problem pollutant(s) and ....obtain more than equivalent offsetting emission reductions (emission offsets) from existing sources."[3]

The second clause of this Ruling has raised numerous questions in presently-designated nonattainment areas regarding opportunities for economic growth. A producer contemplating development of an industrial plant in a nonattainment area might be dissuaded from an affirmative decision if it becomes his or her responsiblility to negotiate source emission reductions from manufacturers already established in that area.

Responding to this concern, many states are investigating the implementation of emissions "banking" accounts for attainment and nonattainment areas alike. As emission reduction credits are determined for various emission control strategies promulgated under state and local programs, these credits are assigned to an economic growth

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[3] Federal Register, Vol. 44, No. 11 - January 16, 1979, p. 3274

"bank" account. This account, after deductions to meet necessary goals for "reasonable further progress" toward attainment of ambient air quality standards, shows the balance of permissible annual emission tonnage increments for industrial and commercial growth.

Inspection/maintenance programs can make a significant contribution to this "bank" account. For the relatively minor inconvenience of an annual emissions check, motor vehicle owners can guarantee that the economic growth potential of their county, region, or state of residence will not be thwarted by an ambient air quality condition over which they have little direct control.

2.7 INTANGIBLE BENEFITS

Benefits over a wide spectrum of health, welfare and aesthetic dimensions have been variously attributed to clean air. Insofar as an I/M program contributes to the attainment of clean air, it shares the credit for these benefits.

Individual perceptions of a "desirable environment" are highly subjective, but several studies have indicated that land values respond positively to improvements in air quality. That is, people prefer to live where clean air is a part of overall aesthetics.

Moreover, clean air has been hypothesized to pay off in reduced health costs and crop damage. A few studies have related foliar damage in trees and crop leaves to the suppression of normal photosynthesis induced by plant exposure to ozone concentrations in excess of the ambient standard for one hour or less. Lack of on-site correlations of monitored ozone concentrations with leaf and crop conditions in Michigan render application of this finding invalid and thus no crop damage hypotheses can presently be upheld.

Evidence for the health benefit of clean air is more amenable to generalization. Among numerous studies commissioned for the purpose of estimating the health costs imposed by various pollutants, one in particular predicted the following damage costs attributable to ozone pollution for four major metropolitan areas in 1975.[4]

REGION	HEALTH COSTS (10^6 Dollars)
New York	21.3
Chicago	16.6
Washington	1.7
Los Angeles	152.5

Symptoms of ozone irritation include eye discomfort (dryness and/or burning), chest discomfort (impaired breathing), coughing, headache, and, in susceptible cases, aggravated asthma or heart and lung disease. Costs are incurred both in the expense resulting from any medical treatment and in lost employee time and productivity owing to impaired function. The magnitude of such negative impacts tends to be greatest in urbanized areas, with relatively larger work forces and generally more days in violation of ambient standard than are the case in less densely developed regions. For this reason, Detroit, Flint, Lansing, and Grand Rapids are likely to be the Michigan locations most vulnerable to the health cost dimension of ozone pollution damage, and it is therefore in just these locations that any I/M program for the purpose of reducing the quantity of airborne, ozone-forming hydrocarbons could produce the greatest net benefit.

In the Detroit area, reduction of ambient carbon monoxide (CO) levels through I/M may also contribute to an improvement in general health and efficiency. Exposure of eight or more hours to CO concentrations of 10 to 15 ppm (the eight-hour ambient standard is violated when CO concentration exceeds 9 ppm) is highly correlated with impaired time-interval discrimination, heart muscle strain owing to decreased oxygen availability in the bloodstream, and occasional severe chest pain in angina-pectoris patients. These conditions are exacerbated for moderate to heavy smokers experiencing elevated ambient CO levels. Studies presently available have not identified any adverse effects on vegetation or materials arising from elevated CO exposure.

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[4] Mathtech, Inc., "A Computer Simulation Model for Analyzing Mobile Source Air Pollution Control Strategies," EPA, September 1976, pp. 29-32

Section 3

INSPECTION MAINTENANCE (I/M) PROGRAM REQUIREMENTS

In this section, each of the factors affecting the magnitude and distribution of program costs will be discussed. Administrative approach and method of test will be reviewed again, since they are the major elements influencing the scale of the program. In addition, information about the geographic areas, vehicle population statistics, inspection lane throughput, and personnel requirements will be evaluated. Other requirements, such as mechanic's training, public information, and consumer protection, will be introduced. The costing categories for each program will be presented in Section 4.

3.1 ADMINISTRATIVE OPTIONS

The administrative approaches characterized in the operational format of the inspection phase of I/M* are as follows:

- State-owned/operated centralized facilities - A public authority manages and operates publicly-owned test facilities.

- Contractor-owned/operated centralized facilities - A private firm, or other entity selected through competitive bidding is delegated operational responsibility for inspection. The contractor, not the State, assumes financial responsibility for constructing and operating test centers. Administrative control is still the responsibility of a public authority.

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*Service garages, dealerships, and independents comprising the repair industry will provide the requisite maintenance for failed vehicles identified by the inspection phase.

- Privately-owned/operated decentralized facilities - A public authority certifies qualified establishments (e.g., independent service garages and dealerships) to perform inspections. The State regulates and oversees the program to ensure that I/M requirements and provisions are met. This system provides a network of decentralized inspection and repair facilities which are certified and controlled by the State.

- Statistical sampling of vehicle population - Statistical sampling relating to an I/M program is the process of collecting I/M data (such as emissions, costs, benefits, and repair information) to provide a basis for trend characteristics.

  A program to test a statistical sample of vehicles has been identified by the Michigan Department of Transportation (MDOT) as a candidate option. It could be operated by either the State or a contractor, but is not acceptable to the Environmental Protection Agency (EPA) because of the questionable effectiveness of the approach.

  The collection of such data on a certain number of vehicles from a specific vehicle population is called a sample of the population. However, the process (whereby the sample is selected) is termed sampling. The nature of the sampling process is likely to determine the success or failure of the conclusions arrived at from the data.

  The method of selecting the sample must ensure the sample will contain the same proportion of age/type/size/make, etc., characteristics of vehicles as contained in the total population. To achieve these objectives, a stratified random sampling technique must be introduced. A "roulette wheel" selection of the area population could be programmed to provide for such a random selection of a stratified sample.

No administrative approach geared to mandatory I/M is intrinsically more effective than another in reducing vehicle emissions. However, the specific administrative approach chosen will have a substantial effect on initial implementation cost, program capital and operational expenditures.

3.2 TEST MODES

The emission test modes identified by the State of Michigan were analyzed with the alternative program scenarios previously outlined. These test modes are:

- Idle-mode test
- Loaded-mode test
- Engine parameter/device inspection

A typical inspection sequence is illustrated in Figure 3-1.

3.2.1 IDLE-MODE TEST

The idle-mode test, which will be costed in Section 5, consists of measuring the exhaust emissions with the vehicle in a neutral gear and the engine at idle. Hydrocarbon (HC) and carbon monoxide (CO) levels are measured at both a normal- and high-idle speed. The test at the normal-idle speed is conducted at the manufacturer's recommended idle (600 to 1,000 revolutions per minute (rpm)) uniformly, while the high-idle speed test is conducted at 2,500 rpm.

The overall test procedure includes the following steps: (1) collection of vehicle number, (2) visual inspection of the exhaust system and emission control devices; (3) the exhaust emission test; and (4) recording of the test data.

Based on the exhaust emission test data, the vehicle will pass or fail. Passed vehicles will be certified and, if indicated by the emission data, impending malfunctions will be discussed with the owner. The vehicle is then released. Failed vehicles will be diagnosed for probable cause of failure and released to the owner for required repair(s). After repair(s), the vehicle will be returned to the facility and retested.

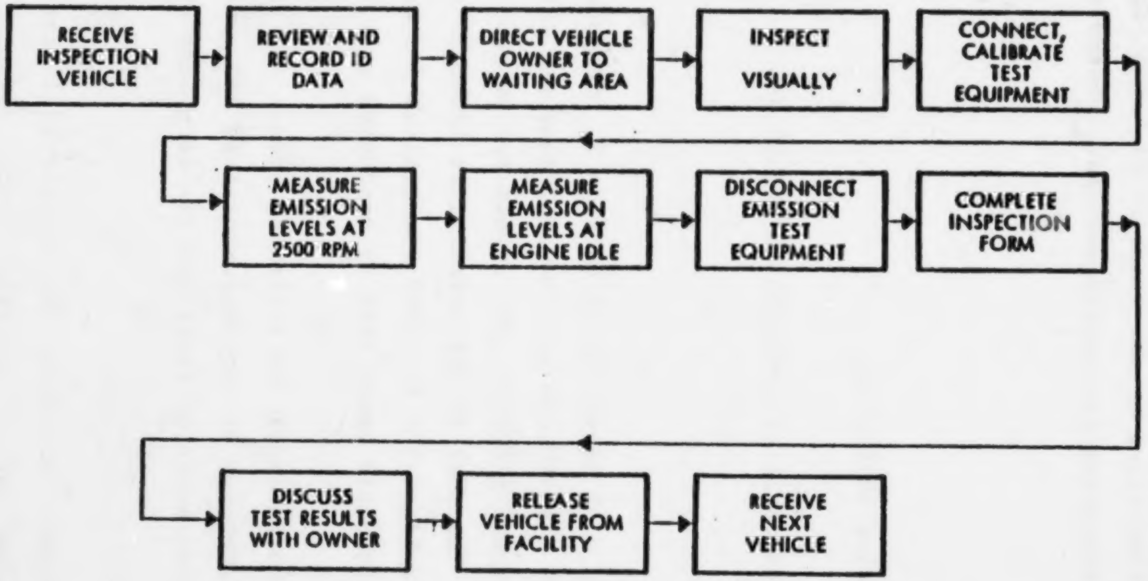
RECEIVE INSPECTION VEHICLE
REVIEW AND RECORD ID DATA
DIRECT VEHICLE OWNER TO WAITING AREA
INSPECT VISUALLY
CONNECT, CALIBRATE TEST EQUIPMENT
MEASURE EMISSION LEVELS AT 2500 RPM
MEASURE EMISSION LEVELS AT ENGINE IDLE
DISCONNECT EMISSION TEST EQUIPMENT
COMPLETE INSPECTION FORM
DISCUSS TEST RESULTS WITH OWNER
RELEASE VEHICLE FROM FACILITY
RECEIVE NEXT VEHICLE

Figure 3-1. Typical Inspection Station

The general characteristics of idle-mode testing are:

- Simple test procedure that requires minimum training for inspectors
- Limited diagnosis of some engine maladjustments and malfunctions
- Duplication by either public or private test systems
- Requires minimal test time and equipment
- Malfunctions that occur under loaded conditions may not be detected
- Oxides of nitrogen (NO_x) testing cannot be performed effectively
- Carburetor adjustment could be made during test

3.2.2 LOADED-MODE TEST

The loaded-mode emission test requires the use of a chassis dynamometer and HC/CO gas analyzers, and an NO_x analyzer (if specified). The test is performed on a simple chassis dynamometer at vehicle speed and load modes that are calculated to expose engine faults. The operational modes are idle, low cruise, and high cruise. After vehicle pretest activities are performed, the vehicle is positioned on the dynamometer and emission test equipment attached. The initial test mode is at high cruise conditions. The driver accelerates to a speed and load range of 44 to 50 mph and 21 to 30 horsepower (hp), depending upon vehicle weight. During this period, the engine temperature is stabilized. High cruise emission measurements are performed and the vehicle speed and load is reduced to 22 to 30 mph and 6 to 12 hp depending again upon vehicle weight. After measurement, the vehicle is allowed to return to idle for final measurements prior to post-test operation. Exact test speeds and loads used depend on vehicle weight.

Different failure limits are established for the HC and CO concentrations for each operational mode. By referring to a logic diagram termed a "truth chart," probable engine malfunctions can be identified. This provides an important diagnostic aid to the repair technician. In addition to the truth tables, a manual containing usage examples may be provided to repair facilities.

3.2.3 ENGINE PARAMETER/DEVICE INSPECTION

In this option, vehicles are subjected to a sequence of inspections to determine the mechanical condition of various emission-related systems. Components and/or operating parameters with measurements outside the accepted tolerance range are considered to have failed, and are required to be replaced or adjusted to manufacturer's specification. Table 3-1 presents test parameters and their emission relationships. This approach does not require measurement of emission levels although, in some cases, emission measurements can be made to evaluate the state of certain vehicle systems (e.g., measurement of idle CO concentration to evaluate proper idle air/fuel ratio adjustment).

Diagnosis of failed vehicles can be complicated. The variations in logic flow that stem from failure contingencies are so numerous that flow diagraming techniques become overwhelming. The diagnostic tasks are divided into emission control system tests, fuel system tests, ignition system tests, and mechanical system tests. Testing for component failure within these system areas is accomplished during various static engine operating modes. The modes are described as prestart, idle, off-idle, and special. Prestart tests generally concern detailed visual inspection of system components. Idle tests involve specific emission control components, idle speed and mixture tests and ignition timing, and point dwell inspection. Off-idle testing is concerned with additional fuel system tests involving air cleaners, power enrichment, and main circuit carburetor condition. Ignition coil, distributor, plugs, and wires are further tested, including mechanical and vacuum advance mechanisms. When mechanical system components such as exhaust or intake valves are suspected of failure, special tests involving static load (power drop) are performed.

The elements of a parameter inspection are flexible and not everyone agrees on which elements should be included. In order to minimize the time of the inspection and still have a meaningful test, SCI has estimated a requirement of 24.4 minutes for the inspection. This allows for a 12.2 minute visual inspection at position one and a 12.2 minute diagnostic hook-up and test a position two. The parameters measured include:

Table 3-1. ENGINE PARAMETER/DEVICE TEST AND EMISSION RELATIONSHIPS

		POLLUTANT EMISSION RELATION		
EMISSION CONTROL SYSTEM	INDICATION OF MALFUNCTION	HC	CO	NO_x
1. Carburetor System				
a. Choke	Adjustment	x	x	
b. Metering rod	Adjustment		x	
c. Power valve	For ruptured diaphragm	x	x	
d. Idle adjustment	Fuel mixture	x	x	
e. Float and valve	Float level		x	
f. Vacuum break valve	Ruptured diaphragm or loose vacuum hose		x	
2. Ignition System				
a. Spark plugs	Electrode deterioration	x	x	
b. Wires	Cable deterioration	x	x	
c. Cap	Terminal corrosion or erosion	x		
d. Rotor	Terminal corrosion or erosion	x		
e. Vacuum advanced	Ruptured diaphragm or loose vacuum		x	x
f. EI Mag trigger	Deterioration		x	
g. Timing	Adjustment			x
3. Thermal Air Inlet	Ruptured diaphragm or loose vacuum hose	x	x	
4. Heat Riser	Stuck	x	x	
5. PCV Components	Clogged	x	x	
6. EGR Components	Stuck			x
7. EVAP Components	Clogged	x		
8. Air Injection System	Broken hose or fault air pump	x	x	
9. Spark Delay Valves	Stuck			x
10. Three-Way Catalyst	High ppm HC	x	x	x
11. Reduction Catalyst	O_2 emissions status[a]			x
12. Oxidation Catalyst	O_2 emissions status[a]	x	x	

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[a] In lieu of O_2 emissions status, a gas sample would have to be checked before and after the catalyst. Visual inspection could be made for a general status; discoloration of the stainless steel case is indicative of higher temperature effects and possible malfunction.

- Oscilloscope check of ignition system
- Distributor vacuum and mechanical advance check
- Dwell check (for vehicles with points)
- Basic timing check
- Idle enrichment check
- RPM check
- EGR vacuum check
- EGR valve stem movement check
- Vacuum check at PCV

3.3 OPTIONAL INSPECTION (SAFETY AND NOISE)

There are several associated programs that can be efficiently integrated with I/M. These programs are categorized as follows: Safety Inspection, Noise Inspection, or Safety and Noise Integrated with I/M.

3.3.1 SAFETY INSPECTION

The vehicle-in-use (VIU) standards and periodic motor vehicle inspection programs presently in operation in other states emphasize safety-related components. There is a general belief that vehicles in good operating condition are less likely to be involved in accidents.

During 1975 and 1976, random check lanes were used to estimate the condition of automobiles in two Michigan counties. This program was called the Michigan Trial Substitute Vehicle Inspection Program; it was a substitute for a fully implemented and mandatory vehicle safety inspection program required by the Federal Highway Administration (FHA). The Michigan program set-up check lanes in two counties. One county checked 5 percent of the cars, and the other checked 15 percent. Results of the program indicated that the effect of the 5 percent program was no different than the effect of the 15 percent.

The following items were checked as part of the safety program:

- Vision Defects - Visual inspection for glass (safety glass, cracked or chipped windows),operating windshield wipers and washers, and condition of mirrors.

- **Lighting Defects** - Headlight aiming and output, high-beam indicator lights, tail lights, stop lights, and license plate lights.

- **Exhaust Defects** - Noise and excessive smoke.

- **Control Defects** - Steering, the foot and parking brake by the wheel-pull method, and by the moving/stopping test method. Tread depth, tire condition, and tire pressure.

- **Miscellaneous Defects** - Horns, licenses and registrations, and seat belts.

The State of Michigan no longer has a safety inspection program for automobiles. The safety program Michigan is considering for implementation with the I/M program is discussed in Volume 1. The safety test discussed in the Section 5 - Cost Analysis is summarized above. Brake testing may be performed by:

- Wheel removal
- Moving/stopping
- Skid plate or low or high speed dynamic brake analyzers

The cost estimates in Section 5 are for the skid plate test method. Most brake testing systems used for safety inspections employ platform brake testers commonly called skid plates. This device consists of four metal pads spaced to accommodate the wheels of an automobile. The pads are connected by a hydraulic linkage to a gauge or display, calibrated in pounds of braking force. The vehicle to be inspected is driven onto the metal pads at a speed of between 4 and 8 miles per hour, the brakes applied so that the vehicle stops on the pads. The force applied to the pads by the vehicle during the braking action pushes the fluid through the return lines. The resultant pressure is indicated on the display. Four separate readings are obtained, one for each wheel. The indicator on the display retains the reading until the vehicle has moved off of the platform. The readings show both left-to-right equalization and front-to-rear imbalance.

The attractiveness of the platform brake tester is its ability to quickly carry out a brake test which indicates both left-to-right equalization and front-to-rear imbalance. This test can usually be accomplished in less than one minute. Because of this, most state- and city-operated inspection programs use this system.

3.3.2 NOISE INSPECTION

Federal "pass-by" noise testing procedures specify a measurement distance of 15 meters (50 feet) between the vehicle and the microphone used to monitor noise. This requires a large, hard surface similar to a highway as a testing site. Low ambient noise levels are also necessary. For noise testing to be included in I/M, it is desirable to test vehicle noise at a shorter distance, in a stationary mode, and to have the results correlate closely with the Federal "pass-by" testing procedures. Previous studies have shown weak correlation with Federal procedures when the microphone distances are varied and the microphone height remains constant. If the microphone height is also adjustable, the correlation improves and noise testing at shorter distances is possible.

It is not necessary to use a dynamometer to simulate driving conditions for noise testing because the instantaneous vehicle noise which is responsible for most noise standard violations depends mostly on the engine power (throttle setting) and the engine speed. This means that a vehicle can be tested in a stationary position, as long as ambient noise levels are acceptable.

The State of Michigan has enacted the following law. Rules for the law's implementation must be promulgated by the MDOT. This includes holding public hearings. The Department of Transportation has proposed that these standards be implemented and enforced partly on a local level and partly by MDOT enforcement terms. MDOT will be providing testing equipment and training to 40 communities throughout the State.

"(1) After April 1, 1978, a motor vehicle shall not be operated or driven on a highway or street if the motor vehicle produces total noise exceeding one of the following limits at a distance of 50 feet except as provided in subdivisions (b)(iii) and (c)(iii):

(a) A motor vehicle with a registered weight of 8,500 pounds or more, singly or towing a semitrailer, pole trailer, or trailer or a combination of those trailers:

(i) Ninety DBA if the maximum lawful speed on the highway or street is treater than 35 miles per hour.

(ii) Eighty-six DBA if the maximum lawful speed on the highway or street is not more than 35 miles per hour.

(iii) Eighty-eight DBA under stationary run-up test.

(b) A motorcycle or a moped as defined by section 32b:

(i) Eighty-six DBA if the maximum lawful speed on the highway or street is greater than 35 miles per hour.

(ii) Eighty-two DBA if the maximum lawful speed on the highway or street is not more than 35 miles per hour.

(iii) Ninety-five DBA under stationary run-up test at 75 inches.

(c) A motor vehicle or a combination of vehicles towed by a motor vehicle not covered in subdivision (a) or (b):

(i) Eighty-two DBA if the maximum lawful speed on the highway or street is greater than 35 miles per hour.

(ii) Seventy-six DBA if the maximum lawful speed on the highway or street is not more than 35 miles per hour.

(iii) Ninety-five DBA under stationary run-up test 20 inches from the end of the tail pipe."

3.4 GEOGRAPHIC AREA OF COVERAGE

3.4.1 NONATTAINMENT AREAS

The MDOT has provided background documentation identifying geographic areas that presently violate air quality standards for CO, photochemical oxidants (O_3), and NO_x.

The nonattainment areas for O_3 are presented in Figure 3-2. The areas of O_3 nonattainment are in the 37 counties in the southern area of Michigan, plus one county in the northern area. In contrast, CO nonattainment is found only in the Detroit metropolitan area as presented in Figure 3-3. The State of Michigan is currently meeting air quality standards for nitrogen dioxide (NO_2). Boundaries of the urban areas of Detroit, Lansing, Flint, and Grand Rapids are shown in Figure 3-4. By provisions of the Clean Air Act, I/M may be implemented

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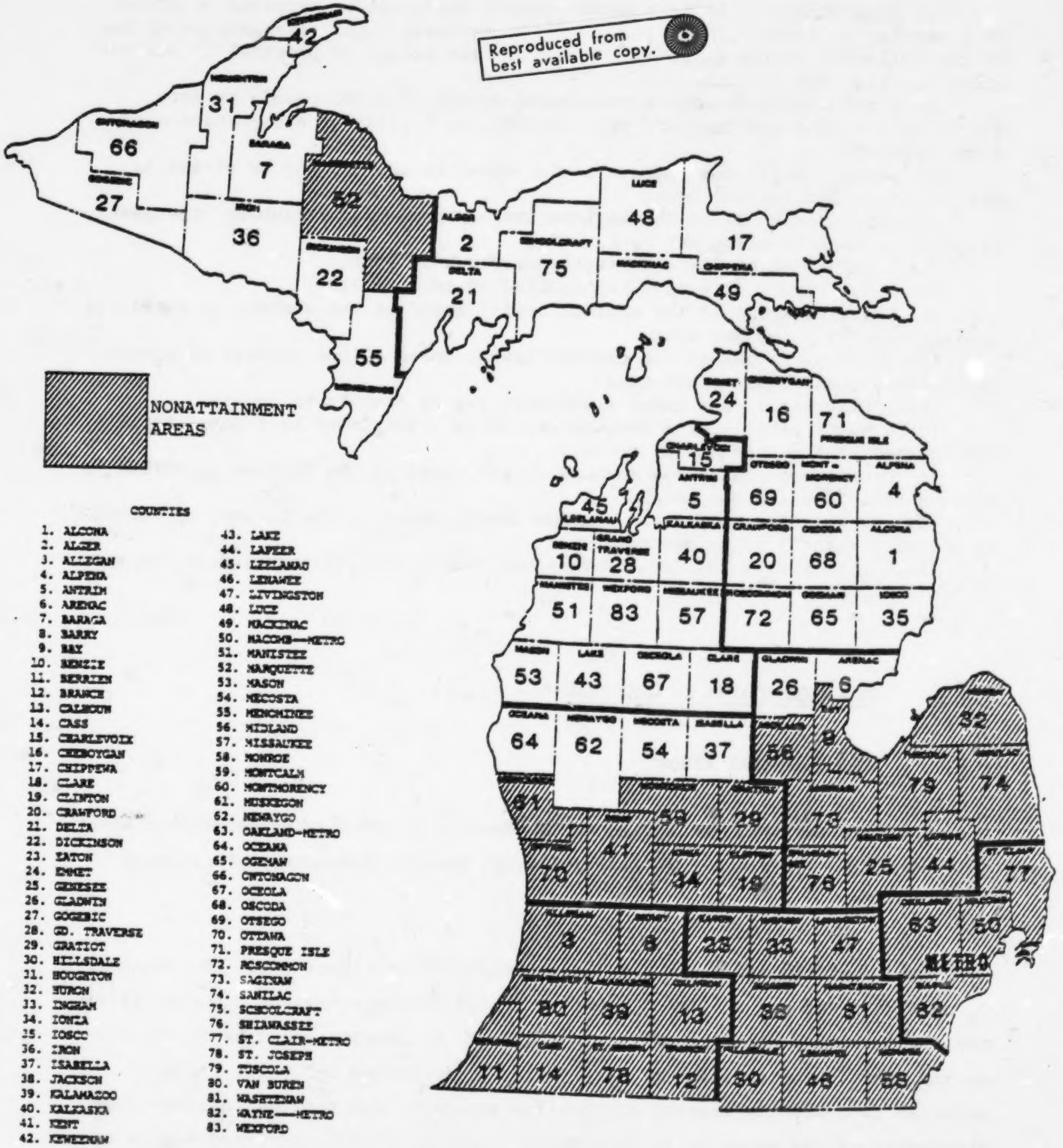
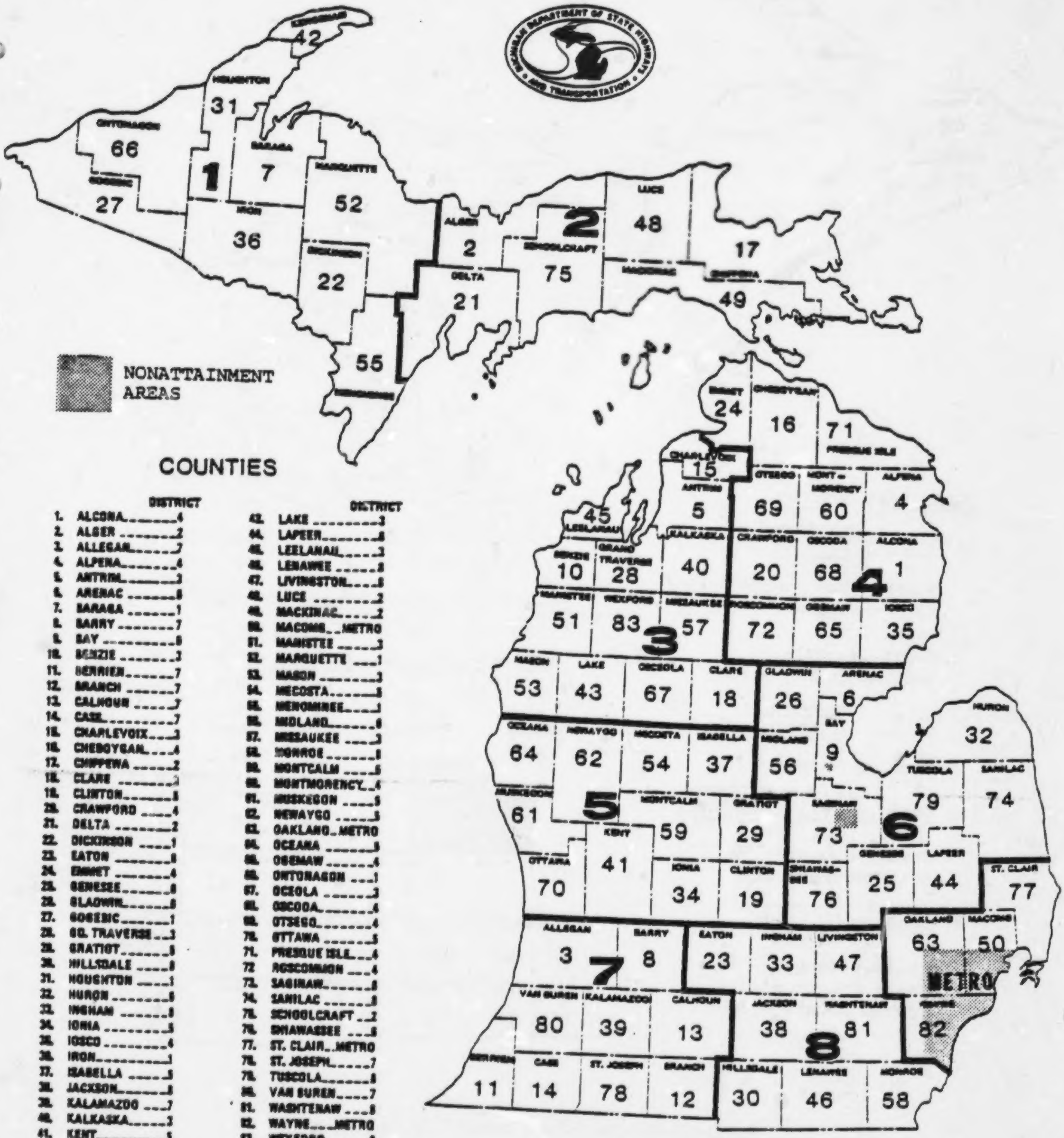


COUNTIES

1. ALCONA
2. ALGER
3. ALLEGAN
4. ALPENA
5. ANTRIM
6. ARENAC
7. BARAGA
8. BARRY
9. BAY
10. BENZIE
11. BERRIEN
12. BRANCH
13. CALHOUN
14. CASS
15. CHARLEVOIX
16. CHEBOYGAN
17. CHIPPEWA
18. CLARE
19. CLINTON
20. CRAWFORD
21. DELTA
22. DICKINSON
23. EATON
24. EMMET
25. GENESEE
26. GLADWIN
27. GOGEBIC
28. GD. TRAVERSE
29. GRATIOT
30. HILLSDALE
31. HOUGHTON
32. HURON
33. INGHAM
34. IONIA
35. IOSCO
36. IRON
37. ISABELLA
38. JACKSON
39. KALAMAZOO
40. KALKASKA
41. KENT
42. KEWEENAW
43. LAKE
44. LAPEER
45. LEELANAU
46. LENAWEE
47. LIVINGSTON
48. LUCE
49. MACKINAC
50. MACOMB—METRO
51. MANISTEE
52. MARQUETTE
53. MASON
54. MECOSTA
55. MENOMINEE
56. MIDLAND
57. MISSAUKEE
58. MONROE
59. MONTCALM
60. MONTMORENCY
61. MUSKEGON
62. NEWAYGO
63. OAKLAND-METRO
64. OCEANA
65. OGEMAW
66. ONTONAGON
67. OCEOLA
68. OSCODA
69. OTSEGO
70. OTTAWA
71. PRESQUE ISLE
72. ROSCOMMON
73. SAGINAW
74. SANILAC
75. SCHOOLCRAFT
76. SHIAWASSEE
77. ST. CLAIR-METRO
78. ST. JOSEPH
79. TUSCOLA
80. VAN BUREN
81. WASHTENAW
82. WAYNE—METRO
83. WEXFORD

Figure 3-2. Michigan Ozone Nonattainment Counties

DISTRICT AND COUNTY NUMBERS



COUNTIES

		DISTRICT
1.	ALCONA	4
2.	ALGER	2
3.	ALLEGAN	7
4.	ALPENA	4
5.	ANTRIM	3
6.	ARENAC	6
7.	BARAGA	1
8.	BARRY	7
9.	BAY	6
10.	BENZIE	3
11.	BERRIEN	7
12.	BRANCH	7
13.	CALHOUN	7
14.	CASS	7
15.	CHARLEVOIX	3
16.	CHEBOYGAN	4
17.	CHIPPEWA	2
18.	CLARE	3
19.	CLINTON	5
20.	CRAWFORD	4
21.	DELTA	2
22.	DICKINSON	1
23.	EATON	8
24.	EMMET	4
25.	GENESEE	6
26.	GLADWIN	6
27.	GOGEBIC	1
28.	GD. TRAVERSE	3
29.	GRATIOT	5
30.	HILLSDALE	8
31.	HOUGHTON	1
32.	HURON	6
33.	INGHAM	8
34.	IONIA	5
35.	IOSCO	4
36.	IRON	1
37.	ISABELLA	5
38.	JACKSON	8
39.	KALAMAZOO	7
40.	KALKASKA	3
41.	KENT	5
42.	KEWEENAW	1
43.	LAKE	3
44.	LAPEER	6
45.	LEELANAU	3
46.	LENAWEE	8
47.	LIVINGSTON	8
48.	LUCE	2
49.	MACKINAC	2
50.	MACOMB	METRO
51.	MANISTEE	3
52.	MARQUETTE	1
53.	MASON	3
54.	MECOSTA	5
55.	MENOMINEE	1
56.	MIDLAND	6
57.	MISSAUKEE	3
58.	MONROE	8
59.	MONTCALM	5
60.	MONTMORENCY	4
61.	MUSKEGON	5
62.	NEWAYGO	5
63.	OAKLAND	METRO
64.	OCEANA	5
65.	OGEMAW	4
66.	ONTONAGON	1
67.	OSCEOLA	3
68.	OSCODA	4
69.	OTSEGO	4
70.	OTTAWA	5
71.	PRESQUE ISLE	4
72	ROSCOMMON	4
73.	SAGINAW	6
74.	SANILAC	6
75.	SCHOOLCRAFT	2
76.	SHIAWASSEE	6
77.	ST. CLAIR	METRO
78.	ST. JOSEPH	7
79.	TUSCOLA	6
80.	VAN BUREN	7
81.	WASHTENAW	8
82.	WAYNE	METRO
83.	WEXFORD	3

Figure 3-3. Carbon Monoxide Nonattainment Areas

in any or all of these areas. They are therefore referred to as the urban I/M option areas.

3.5 VEHICLE POPULATION

Vehicle registration data on light-duty vehicles (LDVs) in 1977 for statewide, nonattainment counties, Grand Rapids, Lansing, Flint, and Detroit were analyzed and are presented in Table 3-2. Based on 1977 registration data, LDV projections in 1983 and 1987 are also presented. A statewide 2.8 percent annual average growth rate was assumed in each county.*

Table 3-2. LIGHT-DUTY VEHICLE POPULATION FIGURES

Motor Vehicle Population	1977 (Base)	1983	1987
Statewide	4,647,450	5,470,040	6,264,760
Nonattainment areas	4,220,800	4,967,970	5,689,760
Grand Rapids	303,330	357,020	408,880
Lansing	194,060	228,400	261,600
Flint	226,910	267,08	305,880
Detroit	2,339,490	2,753,570	3,153,640

Vehicle registration data for such vehicle categories as light-duty trucks (LDT 1: less than 6,001 lb), light-duty trucks (LDT 2: 6,001-8,500 lb), heavy-duty vehicles (greater than 8,500 lb), and motorcycles are presented in Table 3-3. Detailed vehicle registration data are presented in Appendix A. These data are used to determine the number of test lanes and stations needed for the different programs.

Table 3-3. OTHER VEHICLE POPULATION FIGURES (1977)

Vehicle Population	Light-Duty Truck	Medium-Duty Truck	Heavy-Duty Truck	Motorcycle
Statewide	761,811	24,620	84,869	247,420
Nonattainment areas	642,524	21,580	75,917	218,640
Grand Rapids	46,288	1,567	8,451	18,920
Lansing	36,009	1,577	3,573	13,540
Flint	40,239	729	3,415	12,820
Detroit	252,821	8,233	35,262	94,630

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*Provided by the State of Michigan through correspondence.

3.6 INSPECTION LANE REQUIREMENTS

3.6.1 LANE OPERATION

Facilities will consist of one or more multi-position lanes. Regardless of test mode, drive-through facilities are assumed. The first position is the receiving station. Functions typically performed at this position or work station are:

- Vehicle documentation check
- Initial underhood inspection
- Computer data entry

After the receiving station functions are completed, the vehicle will be driven to the second position which is the test station. Typical functions performed at this station are:

- Emission test (manual or automated)
- Engine parameter inspection (if applicable)
- More detailed underhood inspection

After the test station, the vehicle is driven to the certification station. Functions performed at this station are:

- Provide the vehicle owner test results (manual or automatic printout)
- Issue a certificate of compliance
- Issue a failure report with diagnostic information for repair station
- Issue a certificate of waiver

For multi-position test lanes, it is desirable to have the functions performed at each position to take approximately the same time. The longest position time will dictate the output rate.

3.6.2 LANE OUTPUT ANALYSIS

In order to determine the number of lanes required for a geographic area of interest for each test mode alternative, the number of inspections per year per lane must be first determined. The information in the following paragraphs documents the lane capacity for each test mode considered.

3.6.2.1 Idle Mode

It was determined from time and motion studies conducted at various idle I/M programs that each three position lane has an ideal output rate of one vehicle per 2.4 minutes. Therefore, a single idle-inspection lane has an estimated theoretical annual average output rate of 50,000 inspections. This assumes 250 working days per year and an 8 hour work day.

Based upon a 30 percent stringency factor and the assumption of a 60 percent overall efficiency, the effective annual output is 23,000 LDVs per year $(\frac{50,000}{1.3} \times 0.6)$.*

3.6.2.2 Loaded Mode

The loaded mode test consists of three operating modes (0 (idle), 30, and 50 mph). The idle mode consists of two operating modes (idle and 2,500 rpm). The time required per operating mode is approximately 30 seconds. Test set-up and disconnect procedures require about 55 seconds. Therefore, the ideal output rate is one vehicle per 2.9 minutes or 41,400 inspections per year. Using the 30 percent stringency factor and an overall efficiency of 60 percent, the effective output rate is 19,200 LDVs per year.

3.6.2.3 Engine Parameter/Device Inspection

SCI mechanics have estimated that the engine parameter/device inspection would require between 20 to 60 minutes depending upon the thoroughness of the test. As described in Section 3.2.3, a total inspection time of 24.4 minutes is assumed.

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*Current I/M programs are experiencing a 55 to 65 percent overall efficiency.

Utilizing a three-position station the estimated ideal output rate is one vehicle exiting every 12.2 minutes. This will allow 12.2 minutes at each of the positions, yielding an ideal throughput time of 36.6 minutes. Again using the 30 percent stringency factor and an efficiency of 60 percent, the effective output rate is 4,500 LDVs per year.

3.6.2.4 Safety and Noise Inspection

If safety and/or noise inspection is added to any of the above emission inspection test modes, the same throughput rate is assumed. This is accomplished by adding inspection personnel, increasing the number of test lane positions, and adding appropriate equipment per lane.

3.7 PERSONNEL REQUIREMENTS

Inspection personnel required for lane operation will be one inspector for each work position. For a three position lane, three inspectors will be required. In addition to lane personnel, one facility supervisor and one clerk will be required for each facility. Therefore, for a one lane facility, the personnel complement will be five. For a two lane facility, the personnel complement will be eight. These are "in operation" staffing levels to be used for option comparison purposes.

3.8 RELATED ISSUES

3.8.1 STATE LEGISLATION

Individual states are responsible for obtaining the legal authority to implement vehicle I/M programs. Michigan does not have enabling legislation; it will seek legislation during the fall of 1979. Legislation may be general, or may be specific and assign all responsibilities for the program, determine testing procedures, and even set emission standards. Appendix B presents a detailed discussion of the issues that should be considered for inclusion in I/M legislation.

3.8.2 PUBLIC INFORMATION AND PARTICIPATION

While I/M legislation is debated, and after its passage by the Legislature, it is of paramount importance that the citizens of Michigan be kept abreast of all aspects of the impending program which will have an impact on their accustomed activities. The importance of the program as a health benefit, a potential fuel saver, and an economic benefit should be stressed in any public information campaign, to be weighed against the relatively minor inconvenience of an annual emissions check. The Clean Air Act mandates extensive and direct participation of representative public and private interest groups as an element of information diffusion. Groups such as the local Lung Assocation can generally be counted on to communicate the pros and cons of program elements to their respective constituencies.

The basic features of a public information effort and a suggested time line for their implementation in Michigan are presented in Appendix C.

3.8.3 MECHANICS TRAINING

An I/M program will fully succeed with respect to its intended purpose and to the satisfaction of the public only if qualified mechanics perform the repairs necessary to bring polluting vehicles into compliance with emission standards established under this program. Michigan is fortunate to have a vehicle mechanic certification and registration system in use. This system will greatly ease the problem of identifying qualified mechanics to perform vehicle repairs. Whether vehicle inspections are performed at centralized state or contractor facilities or at private garages, additional mechanics must be trained and many mechanics retrained to perform the necessary repairs.

A mechanic training program may be funded directly by the State through class fees paid by individual trainees, or through a combination of these sources--for example, a year of state funding followed by self-supporting courses at the local level. Appendix D discusses possible mechanic training program approaches, procedures for efficient dissemination of required skills, estimated program costs, and an appropriate program timeline. Additional mechanics training cost analysis is included in Section 5 and Appendix F.

3.8.4 CONSUMER PROTECTION AND QUALITY ASSURANCE ISSUES

An effective consumer protection and quality assurance element is important to the effectiveness and acceptance of the I/M program. It is essential that the consumer be protected from inequities in either the inspection or the maintenance phase of the program. In the inspection phase, quality assurance as an aspect of consumer protection strives to guarantee uniformity and a high degree of precision during emissions inspection. In the maintenance phase, consumer protection is designed to protect a motorist from invalid repairs in the event of emissions test failure through such mechanisms as consumer hot lines, repair cost ceilings, waivers, exemptions, and licensing of mechanics and repair facilities. Some of the techniques of quality assurance are periodic calibration, daily operational checks and adjustments, preventive maintenance and major equipment maintenance. Procedures designed to minimize the circumvention of the inspection system should also be an element of consumer protection, in order to preserve fairness in program enforcement. These issues are discussed in greater depth in Appendix E.

Section 4

PROGRAM COST ELEMENTS AND METHODOLOGY

A vehicle emissions testing program requires appropriate emission test equipment, buildings in which to complete the tests, and qualified staff to perform the tests. A program must be managed to assure accuracy and uniformity, to keep records, to arbitrate and resolve disputes, and to handle various administrative tasks inherent in any program. Furthermore, an inspection program must be planned in detail and resources organized in order to provide and maintain the operation of the program as expected and desired.

The costs associated with an I/M program have been organized into three broad categories: initial implementation costs, capital costs, and annual operating costs. These categories were chosen to reflect their differing natures and timing of expenditures, as well as to identify the various types of expenditures that will be required. Not all of the categories are applicable to all program options. Their applicability to various test types and administrative methods is discussed in Section 6.

4.1 METHODOLOGY

The costing of program options utilizes the concept of Life Cycle Costs (LCC) which assures that cost elements are systematically considered over the duration of the program. A LCC model was used to facilitate the option costing process, and has the following format:

$$LCC = \sum_{n=1}^{Y} \left\{ (C_{INV_n} + C_{OP_n}) \right\}$$

where:

LCC = total program cost for expected duration
n = index of years in life-cycle duration
y = expected number of years in life cycle
C_{INV} = program research and development, facility acquisition, and investment expenditures (in dollars)
C_{OP} = operation and maintenance expenditures (in dollars)

Each of the major categories is further defined by identifying the contributing cost elements applicable to the total program. The analysis in this report utilizes 1978 constant dollars.

A discussion of major cost categories follows, with the detailed costing of elements contained in Apprndix F. The discussion and costing follow the organization of Table 4-1.

4.2 INITIAL IMPLEMENTATION AND CAPITAL COSTS (I)

4.2.1 INITIAL IMPLEMENTATION COSTS

After the selection of an I/M option, plans and decisions must be made regarding individual program elements. Test station locations, facility design, actual staffing needs, etc., must all be determined on an operational level before equipment is purchased, personnel hired, contracts bid and let, etc.

Many of these activities would likely be performed by the central office or program administration staff. The various activities performed before the program is operational are discussed below and a brief example of the type of expenses which would be required is presented for each activity.

Table 4-1. COMMON SET OF COST ELEMENTS

ITEM	COST ELEMENT
I.	INITIAL IMPLEMENTATION AND CAPITAL COSTS (NONRECURRING)
	A. Initial Implementation Costs
	1. Site Selection
	2. Bids Preparation and Evaluation
	3. Facilities Design
	4. Training Plan Development
	5. Personnel Selection
	6. Document Preparation
	7. Administrative Support
	8. System Integration, Checkout, and Certification
	9. Test Scheduling System Development
	B. Capital Costs (Construction)
	1. Land and Site Improvement Costs
	a. Land Cost
	b. Site Improvement Costs
	2. Facility Construction
	3. Instrumentation Cost
	4. Office Equipment
	5. Computer Costs
	a. Hardware
	b. Software
	C. Capital Costs (Other)
	1. Administrative Office Equipment
	2. Quality Control Equipment
	a. Mobil Unit
	b. Referee Station
	c. Correlation Car
	3. Consumer Complaint
II.	ANNUAL OPERATING COSTS
	A. Facility Operating Costs
	1. Personnel Costs
	2. Maintenance and Miscellaneous Item Costs
	a. Facility
	b. Equipment
	B. Support Costs
	1. Administrative
	2. Data Analysis
	3. Training
	C. Quality Control Operating Costs
	1. Personnel
	2. Supply
	3. Maintenance
III.	ANCILLARY PROGRAMS ANNUAL OPERATING COSTS
	A. Ancillary Program Costs
	A. Mechanic Training
	B. Public Information Program
	C. Consumer Complaint
	D. Vehicle Test Scheduling Costs

1. Site Selection - After the criteria for station sites have been determined, specific sites must be located before purchases can be made. Examples of types of costs would be mileage and personnel costs for searches.

2. Bids Preparation and Evaluation - The specifications of the program must be written into a "Request for Proposal" (RFP) if a contractor or private garage is selected. If a state run program is chosen, specifications must be developed for operating and test systems. In either case, bidders' qualifications would have to be certified, and contracts drawn for selected suppliers or operators.

3. Facility Design - Test stations must be designed to meet the requirements of the selected program, as well as local zoning ordinances and building codes.

4. Training Plan Development - Testing personnel in the program will need instruction in the theory and operation of test equipment, I/M program operations, station and test lane procedures, and public relations. This training regimen, curriculum, and specific class scheduling must be planned and organized to ensure proper training.

5. Personnel Selection - Various types and levels of skills will be required in an inspection and maintenance program. Personnel selection costs include the costs of determining appropriate qualifications, recruiting, interviewing, and hiring needed personnel.

6. Document Preparation - The progress and development of the program will have to be documented and reported. This cost element represents the clerical, editorial, and reproduction costs incurred for recording the plans and schedules, and decisions made during the implementation period.

7. Administrative Support - This element covers the costs of administrative personnel during facility construction, personnel selection and system integration, checkout, and certification.

8. System Integration, Checkout, and Certification - Prior to opening the inspection system for operation, equipment and testing procedures must be checked to ensure all components work as expected, and that the components work well as a system. This activity would likely be done in two stages. The first of these stages would involve the checkout of individual station equipment after each station has been otherwise made ready for operation. Performance would be compared with purchase and contract specifications, problems would be removed, and the station subjected to test procedures. This may be integrated with personnel training activities.

   The second stage would involve testing of all of the inspection stations as a system. This would be done to assure program-wide uniformity and to test system wide components (such as centralized data collection procedures and equipment).

9. Test Scheduling System Development - Vehicles must be scheduled for testing. Vehicle owners must be notified prior to their scheduled test period and apprised of test station locations. The primary cost in this element is for computer software development.

4.2.2 CAPITAL COSTS (CONSTRUCTION)

Capital costs include the purchase of items such as buildings, land, and equipment as required by the option selected. These expenditures will be made prior to the official starting date of the program, with the capital goods acquired being assumed to last for the 5-year program life.

1. Land and Site Improvement Costs - Station sites identified during the initial implementation period must be purchased. After purchase, nonbuilding site improvements such as paving, landscaping, and special utility connections may be required during and after station construction. This category includes the actual costs of land and nonbuilding improvements to the land itself.

2. Facility Construction - Test stations will be constructed to meet program requirements. This category covers all costs related to the actual building construction, including test lanes, station office areas, and data collection/storage areas.

3. Instrumentation Cost - Test equipment required by the type of test selected for the program will have to be purchased and installed. Some initial equipment calibration is in this cost element. Instrumentation costs include all equipment required for a test lane to operate, as well as tools required for routine maintenance.

4. Office Equipment - Each station will have an office area for administration of the individual station. Some office equipment will be needed to process employee work records and schedules, collect and compile emission data, prepare inspection forms, and if required, collect inspection fees. Office equipment and incidental office supplies are included in this cost element.

5. Computer Costs - Depending upon the amount of automation desired for data collecting, various types of computer equipment may be required both at the station and central office level. This element includes estimated equipment costs for both a manual system and automated system, as well as software for controlling station computer equipment data collection.

4.2.3 CAPITAL COSTS (OTHER)

1. Administrative Office Equipment - Regardless of program type, a state agency will be responsible for managing and coordinating the program. The program administration staff will require office furniture and equipment.

2. Quality Control Equipment - This cost category covers the costs of mobile vans, correlation vehicles, and the referee stations that will be required to ensure ongoing test accuracy, to provide mechanisms

for resolving disputes and granting repair waivers, and to provide back-up testing capabilities in the event of test lane failures.

3. Consumer Complaint - The consumer protection/complaint program is designed to protect consumers from unreasonable repair charges, to monitor repair practices, and to investigate complaints of these practices. Vehicles will be needed for use by personnel to investigate the complaint. The cost of the vehicles is the only item included in this cost element.

4.3 ANNUAL OPERATING COSTS (II)

Operating costs represent expenditures that will be made throughout the program life, and cover personnel costs, equipment and station maintenance, utilities, debt service, and other charges incidental to the operation of an inspection and maintenance program.

4.3.1 FACILITY OPERATING COSTS

1. Personnel - Employees salaries and benefits are the largest cost item in station operation. Benefits include insurance, vacation, retirement, and sick leave.

2. Maintenance and Miscellaneous Item Costs - Inspection equipment will require routine and corrective maintenance for operation to design specifications and program requirements. The costs of operating and maintaining test stations consist of utilities, property taxes, testing and administrative supplies, landscaping, cleaning, or other similar expenses.

4.3.2 SUPPORT COSTS

1. Administrative - A central office staff will be required to administrate and coordinate the activities performed under the I/M program. Depending

on the type of management scheme to be utilized for the program, there may be a number of administrative levels with responsibilities delegated to regional or lower levels. An example of the type of cost involved is:

> Personnel and Office Supplies - These costs cover the salaries and benefits of program administration staff and management. Office space will be obtained for the program administrative staff, and that office stocked with necessary office supplies. Office rent, supply costs, and utilities are costed in this element.

2. Data Analysis - Emission data collected will be analyzed and summarized for use in determining failure rates, vehicle data, repair costs, etc. This information could be utilized for both ongoing operations and for quarterly reports. This cost item includes the cost of collecting and analyzing data, writing, typing, and printing reports.

3. Training - Ongoing personnel training expenditures will be required to keep program employees abreast of changes in automotive emissions technology and to train new employees.

4.3.3 QUALITY CONTROL OPERATING COSTS

The quality control activities utilize mobile vans, correlation vehicles, and referee stations to ensure test accuracy and uniformity throughout the inspection operation. Costs for these activities include personnel who will perform the various quality control tasks, procure associated supplies, and take responsibility for maintenance of the capital equipment utilized in quality control.

4.4 ANCILLARY PROGRAM ANNUAL OPERATING COSTS (III)

4.4.1 MECHANICS TRAINING

The annual costs of a mechanics training program will consist of instructors' salaries, the costs of course materials, classroom space, and certification costs. This program may be self-supporting.

4.4.2 PUBLIC INFORMATION PROGRAM

This category includes the media expenses to inform the public of the program's goals, station locations, consumer protection provisions, and general program operation. Media coverage includes radio, TV, and newspaper advertising, pamphlets, bumper stickers, and presentations.

4.4.3 CONSUMER COMPLAINT

The consumer complaint activities consists of complaint follow up and service industry field checks. Operating costs entailed in the course of these activities are for personnel expenses, vehicle operating and maintenance, and computer time-sharing.

4.4.4 VEHICLE TEST SCHEDULING COSTS

After the method of vehicle owner scheduling has been programmed and integrated with vehicle registration, the cost of the scheduling inspections should consist only of computer processing and core time, inspection notification cards, and postage.

4.5 COST-RELATED ASSUMPTIONS

The cost methodology was based upon the following assumptions:

- The program options are costed and compared over a 5-year period.

- Initial implementation and capital costs are amortized using 6 percent annual interest. Depreciation schedules for different cost elements are as follows:

  - Land = forever (note: value is assumed to remain constant)
  - Facility = 20 years
  - Other = 5 years

- Only single- and double-lane facilities will be built.

- The personnel fringe benefits for all state and contractor employees including sick leave, vacation, retirement, insurance, holidays, etc., are estimated at 25 percent of base rate.

- Contractor burden costs include overhead and general administration (G/A) and are determined as follows:

  - Overhead costs such as certain indirect costs related to corporate and management personnel salaries, travel, and expenses are assumed to be 5 percent of annual operating costs (SCI estimate).

  - G/A costs such as certain indirect costs related to administrative, accounting, purchasing, financing, etc., activities are assumed to be 10 percent of contractor annual operating costs plus overhead (SCI estimate).

  - Contractor's fee or profit is assumed at 10 percent of total cost (SCI estimate).

- State burden cost to cover G/A is estimated at 15 percent of state annual operating cost (MDOT estimate).
    - Burdened labor cost = 1.15x(state annual operating costs).
- All costs are presented in 1978 dollars.
- Facility Construction cost = $20/sq. ft. (MDOT estimate).
- Land Cost (provided by MDOT).

Major metropolitan (over 1,000,000 population)	
Urban	$5.97/sq. ft.
Suburban	$4.02/sq. ft.
Rural	$0.50/sq. ft.
Submetropolitan (200,000-1,000,000 population)	
Urban	$4.02/sq. ft.
Suburban	$1.00.sq. ft.
Rural	$0.11/sq. ft.
Minor metropolitan (under 200,000 population)	
Urban	$2.00/sq. ft.
Suburban	$0.70/sq. ft.

4.6 OPERATIONAL RELATED ASSUMPTIONS

The following operational related assumptions were used in the analyses:

- Effective annual LDV output rate for test modes with and without safety inspection at 30 percent stringency factor per lane are:
    - Idle mode test = 23,000/yr.
    - Loaded mode test = 19,200/yr.
    - Engine parameter/device inspection = 4,500/yr.
- All retested vehicles are assumed to pass.

Section 5

OPTION DEFINITION AND COSTING

The Michigan I/M study includes the evaluation of possible I/M program alternatives and comparison of their potential benefits and costs. The program variables are identified as: administrative approach; method of test, with and without safety and noise inspection; geographic areas; vehicle categories; and stringency factor. There are also other factors subject to program analysis. For example, the test facilities can have up to six test lanes, with each lane having from one to three positions. However, if all possible combinations of these elements were to be considered, more than one million program alternatives would require analysis. It is therefore impractical to analyze all these factors.

In this study, 24 major alternatives are evaluated. They are listed in Table 5-1. However, of the 24 major alternatives, only seven base options are analyzed in detail. They are: base options 1, 2, 3, 5, 7, 9, and 17 shown in Table 5-2. They include all the common primary characteristics of I/M program costs. The remaining 17 options are analyzed in Section 6.

5.1 BASE OPTIONS DEFINTION

The base options have all the following common characteristics:

- Thirty-eight ozone nonattainment counties covered
- Inspection of light-duty passenger vehicles only
- Thirty percent stringency factor

Table 5-1. ADMINISTRATIVE APPROACH VERSUS METHOD OF TEST

Administrative Approach	Method of Test: Idle	Method of Test: Loaded	Method of Test: Engine Parameter/ Device Inspection
State-operated			
Without safety and noise	Option 1*	Option 9*	Option 17*
With safety and noise	Option 2*	Option 10	Option 18
Contractor-operated			
Without safety and noise	Option 3*	Option 11	Option 19
With safety and noise	Option 4	Option 12	Option 20
Private garage			
Without safety and noise	Option 5*	Option 13	Option 21
With safety and noise	Option 6	Option 14	Option 22
Statistical sampling			
Without safety and noise	Option 7*	Option 15	Option 23
With safety and noise	Option 8	Option 16	Option 24

*Base options

Table 5-2. CHARACTERISTICS OF THE BASE OPTIONS ANALYZED IN DETAIL

Base Options	Administrative Approach	Test Mode	Associated Programs	Geographic Area	Vehicle Category*
1	State-operated	Idle	Without safety and noise	Nonattainment	Light-duty
2	State-operated	Idle	With safety and noise	Nonattainment	Light-duty
3	Contractor-operated	Idle	Without safety and noise	Nonattainment	Light-duty
5	Private garage	Idle	Without safety and noise	Nonattainment	Light-duty
7	Statistical sample	Idle	Without safety and noise	Nonattainment	Light-duty
9	State-operated	Loaded	Without safety and noise	Nonattainment	Light-duty
17	State-operated	Engine Parameter/ Device Inspection	Without safety and noise	Monattainment	Light-duty

*Does not include light-duty trucks.

The basic options consider a network of test stations in the nonattainment counties. The nonattainment counties and the associated motor vehicle population are presented in Section 3. The basic options consider only passenger vehicles. Light trucks under 6,001 pounds are included in the discussion of Section 5.9.

The test station is designed for three-position lanes. The single-lane arrangement is necessary to provide convenience for the public in areas having a low vehicle population. It was assumed that the maximum travel (one way) for the worst-case condition (in Marquette County) for a vehicle owner is approximately 30 miles. The average travel is less than 5 miles, and in the Detroit metropolitan area, would vary from 1 to 3 miles.

The assumed stringency factor throughout this analysis is 30 percent, which means the program is designed to fail 30 percent of the vehicles tested. Assuming that all failed vehicles would require retesting before registration, the actual number of inspections to be performed is 30 percent higher than the vehicle population required to participate in the program. For the purpose of this study, no retests are assumed.

The common assumptions are:

- The inspection station work schedule is 8 hours per day, 250 days per year, for a total of 2,000 hours.
- An efficiency factor of 0.60 was used (see Section 3).
- The base option configuration is two lanes.

5.1.1 OPTION COSTS

The costs associated with an I/M program implementation and operation are:

- Initial implementation and capital costs

- Annual operating costs
- Ancillary program costs

Refer to the discussion (see Appendix F) concerning base data and analytical techniques relating to the development of these costs.

To determine the costs, additional assumptions were made. These are:

- Funds for construction costs should be made available in 1982 to assure implementation of program in 1983.

- Vehicle population growth from 1983 to 1987 will be accommodated by additional hours of operation, rather than construction of new inspection facilities.

5.1.2 OPTION-SPECIFIC BENEFITS

Inspection/maintenance is designed to reduce automobile emissions as a means of improving ambient air quality. The magnitude of potential emission reduction is dependent on the type and size of the vehicle population covered by the mandatory program. The failure rate and the nature of mechanics training also influence the magnitude of emission reductions. Although a loaded mode emissions test may be capable of identifying more reasons for emission failure than the idle test, it has not been established that greater emission reductions result when a loaded mode test is used in a program. The U.S. EPA has determined only that a difference in test effectiveness is not recognizable unless repair mechanics are extensively trained in the proper use of loaded test diagnostic information.

Because the remainder of emission reduction variables are held constant over all options, given the proposed stringency factor and establishment of a mechanic training program in Michigan, the emission credits attributable to I/M are essentially the same for all options. The exception is statistical sampling, which captures only a small fraction of total vehicle population, and parameter inspection, for which credits have not yet been established by

The U.S. EPA. Emissions benefits, therefore, are not evaluated in this section for each option, but were discussed for the I/M program as a whole in Section 2.

The variables that differentiate one option from another are administrative framework, test type and scope, and what each option is intended to accomplish. The advantages and disadvantages of these variables as applied to each program type are discussed for each option. The discussions focus on each option's ease of implementation, consumer convenience, consumer protection, flexibility for future modification and financial feasibility. A summary of these criteria is provided below:

- Ease of Implementation - It is generally acknowledged that the procedures involved in government purchases of land, equipment and buildings, or of hiring personnel very often slow the effective implementation of any governmental program. These procedural problems should not be as pronounced with a private contractor or an established repair garage. In this respect, the contractor and the certified garage approaches offer an advantage which may include avoidance of the costs associated with implementation delays.

- Consumer Convenience - The decentralized administrative approach (private garage) has the advantage of offering inspection facilities at numerous convenient locations, while the location of the fewer state- or contractor-operated testing centers may require some motorists to drive farther for an emissions check. The private garage option also offers the opportunity for one-stop inspection and repair. This does not hold true in the state or contractor option.

- Consumer Protection - Consumer protection issues include the consistency of test procedures, proper calibration of test equipment, and a check on the effectiveness of maintenance performed in response to vehicle failure. Consumer protection in respect of the above criteria is easiest to manage in a centralized program where testing and repair are separated. In a private garage program, testing and calibration procedures and quality control may vary from one garage to the next, thereby jeopardizing the validity of test results.

- Flexibility for Future Modification - Flexibility is measured in terms of the ability of the State to expand or diminish the program's scope as changes are warranted, and the ability of the program to accommodate these modifications. The state and contractor options have a greater opportunity for modification than the decentralized garage program. The decentralized program has more facilities and inspectors than a centralized program, and procedural changes must be communicated to a larger and more dispersed group.

- Financial Flexibility - Centralized programs typically require high initial capital outlay for land, buildings, and equipment. This may present a problem for a state-operated program in that the government must raise the necessary funds. One advantage of the contractor centralized approach is that it eliminates the necessity for a State to make such large capital outlays. The private garage (decentralized) approach also holds this advantage over a state-run program, because most of the program capital outlay is for purchase by garages of emission testing equipment which complies with State specifications. Thus, restrictions on a State's ability to raise funds would support the argument for private sector operated programs.

5.2 OPTION 1

The configuration for Option 1 is:

- State-operated
- Idle-mode (automated testing and data processing)
- Without safety and noise inspection

5.2.1 OPTION 1 - DEFINITIONS AND REQUIREMENTS

This option is a state-administered and operated network of idle test stations. The station requirements, based upon the 1983 LDV vehicle population and the 23,000 LDV effective annual output rate (see Section 3), are shown in Table 5-3. Area types were defined in Section 4.5. Detailed lane analysis for each county is presented in Appendix G. Dividing the vehicle population of LDVs for each county in 1983 by the annual effective LDV capacity of an inspection lane determines how many lanes are needed in each county.

Table 5-3. STATION REQUIREMENTS
OPTION 1: STATE-OPERATED, IDLE TEST

Area Type	Single Lane	Double Lane
Metropolitan		
Urban	0	16
Suburban	0	12
Rural	6	0
Submetropolitan		
Urban	0	18
Suburban	40	0
Rural	16	0
Minor metropolitan		
Urban	65	0
Suburban	0	0
TOTAL	127	46

The basic personnel requirements of an I/M program involve both operations and administration. Operating personnel are those directly involved in performing inspections or providing managerial functions at the inspection site. Administrative personnel are involved in operating support programs such as public information, consumer complaint, mechanics training, and quality control, or in providing overall program management and administration. The personnel requirements for Option 1 are shown in Table 5-4.

Referee stations are necessary when any of the following functions are to be performed:

- Investigate consumer complaint cases that require detailed study to establish the validity of the complaint. (The referee station can perform a detailed or gross diagnostic evaluation. The complaint can be resolved from the resulting data.)

- Developed improved testing practices, improved quality control practices, and correlation studies with relation to the Federal Test Procedures (FTP).

- Provide additional testing capacity for short-term overflow of demand.

- Develop diagnostic routines to establish repair effectiveness during during retesting.

The regional office requirements and referee stations for Option 1 are shown in Table 5-5. Regional offices are located in designated test facilities in which the regional manager and secretary are located.

5.2.2 INITIAL IMPLEMENTATION AND CAPITAL COSTS (ONE-TIME COSTS)

The implementation costs, construction costs, and the other capital costs for Option 1 are presented in Tables 5-6, 5-7, and 5-8, respectively.

5.2.3 OPERATIONS COST (ON-GOING COSTS)

The operating costs for both the inspection facilities and ancillary programs are presented in Tables 5-9 and 5-10 for the years 1983 through and including 1987.

Table 5-4. PERSONNEL REQUIREMENTS
OPTION 1: STATE-OPERATED, IDLE TEST

Classification	Personnel: State Administrative	Personnel: Inspection Facility	Personnel: Quality Control	Personnel: Ancillary Program	Total
Program manager	1				1
Quality control manager	1				1
Manager	1				
Environmental engineer	3		6		9
Statistical analyst	2			1	3
Regional manager		13			13
Facility manager		173			173
Technician		657	22		679
Secretary/clerk	7	186	6	3	202
Field investigator	—	—	—	3	3
TOTAL	15	1,029	34	7	1,085

Table 5-5. REFEREE OFFICE AND REGIONAL REQUIREMENTS
OPTION 1: STATE-OPERATED, IDLE TEST

Location	Referee Stations	Regional[a] Offices	Other Courties Served
Kalamazoo	0	1	Branch Allegan Barry Van Buren Kalamazoo St. Joseph Cass Berrien
Grand Rapids	1	1	Kent Ottawa Muskegon
Lansing	1	1	Montcalm Gratiot Ionia Clinton Eaton Ingham Calhoun
Ann Arbor	1	1	Hillsdale Lenawee Jackson Washtenaw Monroe Livingston
Saginaw	-	1	Midland Bay Saginaw Tuscola Huron Sanilac Shiawassee
Flint	1	1	St. Clair Genessee Lapeer
Pontiac	1	2	Oakland
Mt. Clemens	-	1	Macomb
Detroit	1	4	Wayne
TOTAL	6	13	

[a] Regional stations utilize office space in designated inspection facilities for management functions only.

Table 5-6. INITIAL IMPLEMENTATIOAN COSTS[a]
OPTION 1: STATE-OPERATED, IDLE TEST
YEAR - 1982
(1978 Dollars)

Cost Elements	Dollars
1. Site selection	74,200
2. Bid preparation and evaluation	14,800
3. Facilities design	249,100
4. Training plan development	3,500
5. Personnel selection	43,000
6. Document preparation	10,000
7. Administrative support	156,000
8. System integration, check-out and certification	352,500
9. Test scheduling system development	67,000
TOTAL	970,100

[a] All costs were rounded off to hundreds of dollars.

Table 5-7. CAPITAL COSTS (Construction)
OPTION 1: STATE-OPERATED, IDLE TEST
YEAR - 1982
(1978 Dollars)

Cost Elements	Dollars
1. Land and Site Improvement	
Land	6,010,800
Site improvement	3,337,400
2. Facility construction	6,903,600
3. Instrumentation	2,091,500
4. Office equipment	259,500
5. Computer costs	
Hardware	8,869,500
Software	108,000
TOTAL	27,580,300

Table 5-8. CAPITAL COSTS (Other)
OPTION 1: STATE-OPERATED, IDLE TEST
YEAR - 1982
(1978 Dollars)

Cost Elements	Dollars
1. Administrative office equipment	12,000
2. Quality control equipment	
Mobile units (five)	100,400
Referee stations (six)[a]	1,272,000
Correlation car (one)	9,700
3. Consumer complaint (3 complaint inspection cars)	15,000
TOTAL	1,409,100

[a] Including land cost of $512,400 and building cost of $524,400.

Table 5-9.
ANNUAL OPERATING COSTS
OPTION 1: STATE-OPERATED, IDLE TEST
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Facility operation						
Personnel	13,796,480	14,182,781	14,579,898	14,988,135	15,407,802	72,955,100
Maintenance and miscellaneous costs						
-Facility	1,136,800	1,136,800	1,136,800	1,136,800	1,136,800	5,684,000
-Equipment	514,700	514,700	514,700	514,700	514,700	2,573,500
2. Support						
Administration	320,300	320,300	320,300	320,300	320,300	1,601,500
Data analyses	45,000	45,000	45,000	45,000	45,000	225,000
Training[a]	149,200	149,200	149,200	149,200	149,200	746,000
3. Quality control costs						
Personnel	529,800	529,800	529,800	529,800	529,800	2,649,000
Supply	3,400	3,400	3,400	3,400	3,400	17,000
Maintenance	46,800	46,800	46,800	46,800	46,800	234,000
TOTAL	16,542,480	16,928,781	17,325,898	17,734,135	18,153,802	86,685,100

[a] Total number of employees: 1,085

Table 5-10.
ANCILLARY PROGRAMS OPERATING COSTS
OPTION 1: STATE-OPERATED, IDLE TEST
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Mechanic training	a	a	a	a	a	a
2. Public information	1,242,000	1,276,000	1,311,700	1,348,400	1,386,200	6,564,300
3. Consumer complaint	451,000	451,000	451,000	451,000	451,000	2,255,000
4. Vehicle test scheduling	1,720,400	1,720,400	1,720,400	1,720,400	1,720,400	8,602,000
TOTAL	3,413,400	3,447,400	3,483,100	3,519,800	3,557,600	17,421,300

[a] Self-supporting operation

5.2.4 ANNUALIZED PROGRAM COSTS

The annualized program costs shown in Table 5-11 include capital recovery of the cost of implementation, construction, and other capital using an interest figure of 6 percent per annum.* The total annualized cost in 1978 dollars is $28,282,618.

5.2.5 CONSUMER FEES

The average vehicle owner fee (in 1978 dollars) for Option 1 for an average yearly passenger vehicle population of 5,320,000 over 5 years of program operation is $5.32.

5.2.6 BENEFITS

In this type of program, all administrative and operational responsibilities are vested in governmental agencies of the State of Michigan.

With respect to its ease of implementation, a state usually imposes limitations on hiring of employees, requires that buildings and equipment meet certain specifications, and imposes certain regulations regarding capital expenditures. The time required to obtain approval usually has a significant effect on the implementation of a state-operated program. State agencies wishing to employ personnel for such a program have to request these personnel through the State Civil Service. Since appropriations are based on specific personnel ceilings, requests for personnel to staff an emissions I/M program have to be approved by the State Legislature in advance of the date they are actually required for operations of the program. In addition, it is usually difficult to hire part-time personnel to accommodate the peak demand period. Similarly, agency requests for estimated capital expenditures for land, buildings, and equipment to be used in state-operated centralized facilities must be appropriated by the legislature. However, land and buildings for such a

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*The State of Michigan has identified the program funding would be provided under the State of Michigan's Motor Vehicle Highway Fund at a 6 percent interest rate.

Table 5-11.
ANNUALIZED PROGRAM COSTS AND CONSUMER FEE
OPTION 1: STATE-OPERATED, IDLE TEST
(1978 DOLLARS)

Category	Cost	Capital Recovery Factor	Annualized Cost
1. Initial implementation costs	970,100	0.2374	230,300
2. Capital costs (construction)			
Land	6,010,800	0.06	360,600
Facility and site improvement	10,241,000	0.0872	893,000
Equipment	11,328,500	0.2374	2,689,400
3. Capital costs (other)			
Land[a]	512,400	0.06	30,700
Facility and site improvement[a]	524,400	0.0872	45,700
Equipment	372,300	0.2374	88,400
4. Subtotal (Items 1, 2, and 3)			4,338,100
5. Annual operating costs	17,337,020	1	17,337,020
6. Ancillary program costs[b]	3,484,300	1	3,484,300
7. Subtotal (Items 5 and 6)			20,821,320
8. G/A (@ 15% on Items 5 and 6)			3,123,198
9. Total (Items 4, 7, and 8)			28,282,618

Consumer Fee = $28,282,618/5,320,000 = $5.32

[a] Referee stations impose land and building construction costs

[b] Average over 5 years

program might be leased, rather than purchased, thus alleviating the requirement for large capital outlay by the State.

Consumer convenience is essentially the same for state- and contractor-centralized programs. The number of stations in a centralized program is limited and, even if they are located with maximum accessibility in mind, most motorists are required to travel out of their neighborhoods to undergo the emission test itself and, if required, repair and retest. Nevertheless, consumers are better protected under a centralized program. A centralized program assures consumers accurate and consistent test results. Each vehicle is tested by an organization having no special interest in auto repairs. Testing is conducted in high-volume facilities designed for the purpose and utilizing standardized procedures and specially trained personnel. Furthermore, a centralized program facilitates automated data collection and analysis to eliminate errors in the recording of test results.

Flexibility for future modification is possibly the greatest in the State-operated program, but depends upon the enacted legislation. Developments that would require program modification include (1) change in emission standards, (2) change in program scope, and (3) change in equipment or program operations. For each of these contingencies, the State-operated program has maximum flexibility for modification because no contractual changes would be required.

Because the program is expected to be self-sustaining, the major item concerned with financial feasibility is implementation costs. Initial financing could be provided by the State Treasury from general revenues or obtained through a bond issue (which may not be possible under current Michigan law). In either case, the costs impose significant financial responsibilities on the State.

This option involves idle mode testing. This type of testing entails the least cost for equipment. The basic idle mode test requires the use of an emission analyzer which costs from $1,500 to $4,000 per unit. The cost for training test technicians/inspectors is also lower for idle mode equipment.

As discussed earlier, the idle mode is capable of achieving substantial emission reductions when used in conjunction with a reasonable stringency factor. It should be noted that, if the mode of testing is projected to change during the course of the program, this option offers the opportunity for constructing test facilities that can later be adapted to loaded mode, parameter/device, or other FTP-correlatable short test procedures.

5.3 OPTION 2

The configuration for Option 2 is:

- State-operated
- Idle-mode (automated testing and data processing)
- With safety and noise inspection

5.3.1 OPTION 2 - DEFINITIONS AND REQUIREMENTS

This option is a state-administered and operated network of idle test stations. The station requirements, based upon the 1983 LDV vehicle population and the 23,000 LDV effective annual output rate (see Section 3), are shown in Table 5-12. Area types were defined in Section 4.5. Detailed lane analysis for each county is presented in Appendix G. Dividing the vehicle population of LDVs for each county in 1983 by the annual effective LDV capacity of an inspection lane determines how many lanes are needed in each county.

Table 5-12. STATION REQUIREMENTS
OPTION 2: STATE-OPERATED, IDLE TEST WITH
SAFETY AND NOISE INSPECTION

Area Type	Single Lane	Double Lane
Metropolitan		
Urban	0	16
Suburban	0	12
Rural	6	0
Submetropolitan		
Urban	0	18
Suburban	40	0
Rural	16	0
Minor metropolitan		
Urban	65	0
Suburban	0	0
TOTAL	127	46

Additional equipment cost associated with the safety inspection is presented in Table 5-13. There are three options for brake test under safety inspection (Table 5-14). In the cost analysis, skid-plate testing was used for the brake test. Noise testing would require an additional $582 per lane

Table 5-13. NOISE AND SAFETY EQUIPMENT[a]

Equipment	Per Unit	Per 2-Lane Facility	
Sound-level meter	$ 582.00	(2)	$ 1,164.00
Tire depth gauge	5.00	(2)	10.00
Headlamp aimer	175.00	(2)	350.00
Brake tester (plate)	13,000.00	(2)	26,000.00
Total	$13,762.00		$27,524.00

[a] Additional equipment for converting an idle mode station to one with safety and noise capabilities.

Table 5-14. COMPARATIVE MATRIX ANALYSIS FOR BRAKE TESTING

		Strategy		
Item	Cost Consideration	Wheel[a] Pull	Moving/ Stopping	Skid Plate
1	Land cost increase from base unit	20 percent	114 percent	0
2	Operating time to accomplish test	15 minutes	3 minutes	0.0 min.[b]
3	Lane requirement[c] (increase)	need 4-5 bays added for wheel pulling	0	0
4	Equipment cost (increase)	0	0	$13,000.00
5	Maintenance cost (increase)	$300.00	$300.00	$ 1,300.00/yr
6	Personnel (increase)	5 persons	1 person	1 person

[a] Wheel pulling does not provide for complete inspection of the brake system, as only one wheel is pulled.

[b] The brake test is performed while moving the vehicle from position one to position two.

[c] The side bays for wheel pulling are necessary to provide for the vehicle throughput rate as noted under Item 3.

for noise testing equipment. Two additional inspectors per lane over Option 1 will be required to maintain the same output rate and perform the safety and noise inspections.

The basic personnel requirements of an I/M program involve both operations and administration. Operating personnel are those directly involved in performing inspections or providing managerial functions at the inspection site. Administrative personnel are involved in operating support programs such as ancillary programs and quality control, or in providing overall program management and administration. The personnel requirements for Option 2 are shown in Table 5-15.

Referee stations are necessary when any of the following functions are to be performed:

- Investigate consumer complaint cases that require detailed study to establish the validity of the complaint. (The referee station can perform either a detailed or gross diagnostic evaluation. The complaint can be resolved from the resulting data.)

- Develop improved testing practices, improved quality control practices, and correlation studies with relation to the Federal Test Procedures (FTP).

- Provide additional testing capacity for short-term overflow of demand.

- Develop diagnostic routines to establish repair effectiveness during retesting.

The regional office requirements and referee stations for Option 2 are shown in Table 5-16. Regional offices are located in designated test facilities in which the regional manager and secretary are located.

Table 5-15. PERSONNEL REQUIREMENTS OPTION 2: STATE-OPERATED, IDLE TEST WITH SAFETY AND NOISE INSPECTION

	PERSONNEL				
CLASSIFICATION	State Administrative	Inspection Facility	Quality Control	Ancillary Program	TOTAL
Program manager	1				1
Quality control manager	1				1
Manager	1				1
Environmental engineer	3		6		9
Statistical analyst	2			1	3
Regional manager		13			13
Facility manager		173			173
Technician		1,095	22		1,117
Secretary/clerk	7	186	6	3	202
Field investigator	—	—	—	3	3
TOTAL	15	1,467	34	7	1,523

Table 5-16. REFEREE AND REGIONAL STATION REQUIREMENTS
OPTION 2: STATE-OPERATED, IDLE TEST WITH SAFETY AND NOISE INSPECTION

Location	Referee Stations	Regional[a] Offices	Other Counties Served
Kalamazoo	0	1	Branch Allegan Barry Van Buren Kalamazoo St. Joseph Cass Berrien
Grand Rapids	1	1	Kent Ottawa Muskegon
Lansing	1	1	Montcalm Gratiot Ionia Clinton Eaton Ingham Calhoun
Ann Arbor	1	1	Hillsdale Lenawee Jackson Washtenaw Monroe Livingston
Saginaw	-	1	Midland Bay Saginaw Tuscola Huron Sanilac Shiawassee
Flint	1	1	St. Clair Genessee Lapeer
Pontiac	1	2	Oakland
Mt. Clemens	-	1	Macomb
Detroit	1	4	Wayne
TOTAL	6	13	

[a] Regional stations utilize office space in designated inspection facilities for management functions only.

5.3.2 INITIAL IMPLEMENTATION AND CAPITAL COSTS (ONE-TIME COSTS)

The implementation costs, construction costs, and the other capital costs for Option 2 are presented in Tables 5-17, 5-18, and 5-19, respectively.

5.3.3 OPERATIONS COST (ON-GOING COSTS)

The operating costs for both the inspection facilities and ancillary programs are presented in Tables 5-20 and 5-21 for the years 1983 through and including 1987.

5.3.4 ANNUALIZED PROGRAM COSTS

The annualized program costs shown in Table 5-22 include capital recovery of the cost of implementation, construction, and other capital using an interest figure of 6 percent per annum.* The total annualized cost in 1978 dollars is $37,419,700.

5.3.5 CONSUMER FEES

The average vehicle owner fee (in 1978 dollars) for Option 2 for an average yearly vehicle population of 5,320,000 over 5 years of program operation is $7.04.

5.3.6 BENEFITS

The State of Michigan has performed extensive analysis on the benefits of a safety testing program, the results of which are not discussed in this report.

Michigan also regulates vehicle noise levels, the context of which is discussed in Section 3.3.2. This regulation is not presently in operation but is expected to be implemented in the near future. Enforcement will be simplified if the noise standard compliance test is coupled with the emissions inspection at a "one-stop" facility.

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*The State of Michigan has identified the program funding would be provided under the State of Michigan's Motor Vehicle Highway Fund at a 6 percent interest rate.

Table 5-17. INITIAL IMPLEMENTATION COSTS[a]
OPTION 2: STATE-OPERATED, IDLE TEST WITH SAFETY AND NOISE INSPECTION, YEAR - 1982
(1978 Dollars)

Cost Elements	Dollars
1. Site selection	74,200
2. Bid preparation and evaluation	14,800
3. Facilities design	249,100
4. Training plan development	3,500
5. Personnel selection	43,000
6. Document preparation	10,000
7. Administrative support	156,000
8. System integration, check-out and certification	352,500
9. Test scheduling system development	67,000
TOTAL	1,294,000

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[a] All costs were rounded off to hundreds of dollars.

Table 5-18. CAPITAL COSTS (Construction)
OPTION 2: STATE-OPERATED, IDLE TEST WITH SAFETY AND NOISE INSPECTION
YEAR - 1982
(1978 Dollars)

Cost Elements	Dollars
1. Land and site improvement	
Land	6,010,800
Site improvement	3,337,400
2. Facility construction[a]	11,460,000
3. Instrumentation[b]	5,105,400
4. Office equipment	259,500
5. Computer costs	
Hardware	8,869,500
Software	108,000
TOTAL	35,150,600

[a] 66 percent increase on Option 1 for allowing two more test stations at each facility.

[b] Including additional $13,762 per lane for safety and noise equipment.

Table 5-19. CAPITAL COSTS (Other)
OPTION 2: STATE-OPERATED, IDLE TEST WITH SAFETY AND NOISE INSPECTION
YEAR - 1982
(1978 Dollars)

Cost Elements	Dollars
1. Administrative office equipment	12,000
2. Quality control equipment	
Mobile units (five)	100,400
Referee stations[a] (six)	1,272,000
Correlation car (one)	9,700
3. Consumer complaint (3 complaint inspection cars)	15,000
TOTAL	1,409,100

[a] Including land cost of $512,400 and building cost of $524,400.

Table 5-20.
ANNUAL OPERATING COSTS
OPTION 2: STATE-OPERATED, IDLE TEST WITH SAFETY AND NOISE INSPECTION
(1978 DOLLARS)

COST ITEMS	1983	1984	1985	1986	1987	TOTAL
1. Facility operation						
Personnel[a]	19,331,048	19,872,317	20,428,741	21,000,746	21,588,766	102,221,600
Maintenance and miscellaneous costs						
-Facility[b]	1,887,100	1,887,100	1,887,100	1,887,100	1,887,100	9,435,500
-Equipment	821,300	821,300	821,300	821,300	821,300	4,106,500
2. Support						
Administration	320,300	320,300	320,300	320,300	320,300	1,601,500
Data analyses	45,000	45,000	45,000	45,000	45,000	225,000
Training[b]	149,200	149,200	149,200	149,200	149,200	746,000
3. Quality control costs						
Personnel	529,800	529,800	529,800	529,800	529,800	2,649,000
Supply	3,400	3,400	3,400	3,400	3,400	17,000
Maintenance	46,800	46,800	46,800	46,800	46,800	234,000
TOTAL	23,133,948	23,675,217	24,231,641	24,803,646	25,391,666	121,236,100

[a] Including additional $25,272 per lane to account for two safety and noise inspectors.

[b] Assuming 66% increase in facility maintenance cost.

Table 5-21.
ANCILLARY PROGRAMS OPERATING COSTS
OPTION 2: STATE-OPERATED, IDLE STATION WITH SAFETY AND NOISE INSPECTION
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	TOTAL
1. Mechanic training	a	a	a	a	a	a
2. Public information	1,242,000	1,276,000	1,311,700	1,348,400	1,386,200	6,564,300
3. Consumer complaint	451,000	451,000	451,000	451,000	451,000	2,255,000
4. Vehicle test scheduling	1,720,400	1,720,400	1,720,400	1,720,400	1,720,400	8,602,000
TOTAL	3,413,400	3,447,400	3,483,100	3,519,800	3,557,600	17,421,300

[a] Self-supporting operation

Table 5-22.

ANNUALIZED PROGRAM COSTS AND CONSUMER FEE

OPTION 2: STATE-OPERATED, IDLE TEST WITH SAFETY AND NOISE INSPECTION

Category	Cost	Capital Recovery Factor	Annualized CostT
1. Initial implementation costs	1,294,000	0.2374	307,200
2. Capital costs (construction)			
Land	6,010,800	0.06	360,700
Facility & site improvement	14,797,400	0.0872	1,290,300
Equipment	14,342,400	0.2374	3,404,900
3. Capital costs (other)			
Land[a]	512,400	0.06	30,700
Facility & site improvement[a]	524,400	0.0872	45,700
Equipment	372,300	0.2374	88,400
4. Subtotal (Items 1, 2, and 3)			5,527,900
5. Annual operating costs	24,247,700	1	24,247,700
6. Consumer protection costs[b]	3,484,300	1	3,484,300
7. Subtotal (Items 5 and 6)			27,732,000
8. G/A (@15% on Items 5 and 6)			4,159,800
TOTAL (Items 4, 7, and 8)			37,419,700

Consumer Fee = $37,419,700/5,320,000 =$7.04

[a] Referee stations impose land and building construction costs

[b] Average over 5 years

5.4 OPTION 3

The configuration for Option 3 is:

- Contractor-operated
- Idle-mode (automated testing and data processing)
- Without safety and noise inspection

5.4.1 OPTION 3 - DEFINITIONS AND REQUIREMENTS

This option is a contractor-operated network of idle test stations with the State administering all other functions performed in Option 1. The station requirements, based upon the 1983 LDV vehicle population and the 23,000 LDV effective annual output rate (see Section 3), are shown in Table 5-23. Area types were defined in Section 4.5. Detailed lane analysis for each county is presented in Appendix G. Dividing the vehicle population of LDVs for each county in 1983 by the annual effective LDV capacity of an inspection lane determines how many lanes are needed in each county.

Table 5-23. STATION REQUIREMENTS
OPTION 3: CONTRACTOR-OPERATED, IDLE TEST

Area Type	Single Lane	Double Lane
Metropolitan		
Urban	0	16
Suburban	0	12
Rural	6	0
Submetropolitan		
Urban	0	18
Suburban	40	0
Rural	16	0
Minor metropolitan		
Urban	65	0
Suburban	0	0
TOTAL	127	46

The basic personnel requirements of an I/M program involve both operation and administration. Operating personnel are those directly involved in performing inspections or providing managerial functions at the inspection site. Administrative personnel are involved in operating support programs such as ancillary programs and quality control, or in providing overall program management and administration. The personnel requirements for Option 3 are shown in Table 5-24.

Referee stations are necessary when any of the following functions are to be performed:

- Investigate certain consumer complaint cases that require detailed study to establish the validity of the complaint. (The referee station can perform either a detailed or gross diagnostic evaluation. The complaint can be resolved from the resulting data.)
- Develop improved testing practices, improved quality control practices, and correlation studies with relation to the Federal Test Procedures (FTP).
- Develop diagnostic routines to establish repair effectiveness during retesting.

The regional office requirements and referee stations for Option 3 are shown in Table 5-25. Regional offices are located in designated test facilities in which the regional manager and secretary are located.

5.4.2 INITIAL IMPLEMENTATION AND CAPITAL COSTS (ONE-TIME COSTS)

The implementation costs, construction costs, and the other capital costs for Option 3 are presented in Tables 5-26, 5-27, and 5-28, respectively.

5.4.3 OPERATIONS COST (ON-GOING COSTS)

The operating costs for both the inspection facilities and ancillary programs are presented in Tables 5-29 and 5-30 for the years 1983 through and including 1987.

Table 5-24.
PERSONNEL REQUIREMENTS
OPTION 3: CONTRACTOR-OPERATED, IDLE TEST

CLASSIFICATION	PERSONNEL State Administrative[a]	Inspection Facility[b]	Quality Control[a]	Ancillary Program[a]	TOTAL
Program manager	1				1
Quality control manager	1				1
Manager	1				1
Environmental engineer	3		6		9
Statistical analyst	2			1	3
Regional manager		13			13
Facility manager		173			173
Technician		657	22		679
Secretary/clerk	7	185	6	3	202
Field investigator				3	3
TOTAL	15	1,029	34	7	1,085

[a] State personnel

[b] Contractor personnel

Table 5-25. REFEREE AND REGIONAL STATION REQUIREMENTS OPTION 3: CONTRACTOR-OPERATED, IDLE TEST

Location	Referee Stations	Regional[a] Offices	Other Counties Served
Kalamazoo	1	1	Branch Allegan Barry Van Buren Kalamazoo St. Joseph Cass Berrien
Grand Rapids	1	1	Kent Ottawa Muskegon
Lansing	1	1	Montcalm Gratiot Ionia Clinton Eaton Ingham Calhoun
Ann Arbor	1	1	Hillsdale Lenawee Jackson Washtenaw Monroe Livingston
Saginaw	-	1	Midland Bay Saginaw Tuscola Huron Sanilac Shiawassee
Flint	1	1	St. Clair Genessee Lapeer
Pontiac	1	2	Oakland
Mt. Clemens	-	1	Macomb
Detroit	1	4	Wayne
TOTAL	6	13	

[a] Regional stations utilize office space in designated inspection facilities for management functions only

Table 5-26. INITIAL IMPLEMENTATION COSTS OPTION 3: CONTRACTOR-OPERATED, IDLE TEST YEAR - 1982 (1978 Dollars)

Cost Elements	Dollars
1. Site selection[a]	74,200
2. Bid preparation and evaluation[a]	14,800
3. Facilities design[b]	249,100
4. Training plan development[a]	3,500
5. Personnel selection[c]	43,000
6. Document Preparation[a]	10,000
7. Administrative support[a]	156,000
8. System integration, check-out and certification	352,500
9. Test scheduling system development[a]	67,000
TOTAL	970,100

[a] State cost

[b] Contractor cost

[c] State cost is \$2,200 (= \$43,000 x $\frac{56}{1085}$)
Contractor cost is \$40,800

Table 5-27. CAPITAL COSTS (Construction)
OPTION 3: CONTRACTOR-OPERATED, IDLE TEST
YEAR - 1982
(1978 Dollars)

Cost Elements	Dollars
1. Land and site improvement	
Land[a]	6,010,800
Site improvement[a]	3,337,400
2. Facility construction[a]	6,903,600
3. Instrumentation[a]	2,091,500
4. Office equipment[a]	259,500
5. Computer costs	
Hardware[a]	8,869,500
Software[b]	108,000
TOTAL	27,580,300

[a] Contractor cost

[b] State cost

Table 5-28. CAPITAL COSTS (Other)[a]
OPTION 3: CONTRACTOR-OPERATED, IDLE TEST
YEAR - 1982
(1978 Dollars)

Cost Elements	Dollars
1. Administrative office equipment	12,000
2. Quality control equipment	
Mobile units (five)	100,400
Referee stations[b] (six)	1,272,000
Correlation car (one)	9,700
3. Consumer complaint (3 complaint inspection cars)	15,000
TOTAL	1,409,100

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[a] Cost to the State

[b] Including land cost of $512,400 and building cost of $524,400

Table 5-29.
ANNUAL OPERATING COSTS
OPTION 3: CONTRACTOR-OPERATED, IDLE TEST
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Facility operation[a]						
Personnel	13,796,480	14,182,781	14,579,898	14,988,135	15,407,802	72,955,100
Maintenance and miscellaneous costs						
-Facility	1,332,800	1,332,800	1,332,800	1,332,800	1,332,800	6,664,000
-Equipment	514,700	514,700	514,700	514,700	514,700	2,573,500
2. Support						
Administration[b]	320,300	320,300	320,300	320,300	320,300	1,601,500
Data analyses[b]	45,000	45,000	45,000	45,000	45,000	225,000
Training[c]	149,200	149,200	149,200	149,200	149,200	746,000
3. Quality control costs[b]						
Personnel	529,800	529,800	529,800	529,800	529,800	2,649,000
Supply	3,400	3,400	3,400	3,400	3,400	17,000
Maintenance	46,800	46,800	46,800	46,800	46,800	234,000
TOTAL[d]	16,738,480	17,124,781	17,521,898	17,930,135	18,349,802	87,665,100

[a] Contractor cost

[b] State Cost

[c] State cost $7,700 per year; contractor cost $141,500 per year

[d] The total State cost for 5-year operation is $4,765,000 and $82,900,100 for contractor

Table 5-30.
ANCILLARY PROGRAMS OPERATING COSTS
OPTION 3: CONTRACTOR-OPERATED, IDLE TEST
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Mechanic training	a	a	a	a	a	a
2. Public information	1,242,000	1,276,000	1,311,700	1,348,400	1,386,200	6,564,300
3. Consumer complaint	451,000	451,000	451,000	451,000	451,000	2,255,000
4. Vehicle test scheduling	1,720,400	1,720,400	1,720,400	1,720,400	1,720,400	8,602,000
TOTAL	3,413,400	3,447,400	3,483,100	3,519,800	3,557,600	17,421,300

[a] Self-supporting operation

5.4.4 ANNUALIZED PROGRAM COSTS

The annualized program costs shown in Tables 5-31 and 5-32 for both the State and contractor include capital recovery of the cost of implementation, construction, and other capital using an interest figure of 6 percent per annum.* The total annualized costs in 1978 dollars are:

Contractor	State	Total
$25,541,670	$5,371,100	$30,912,770

5.4.5 CONSUMER FEES

The average vehicle owner fee (in 1978 dollars) for Option 3 for an average yearly vehicle population of 5,320,000 over 5 years of program operation is:

Contractor	State	Total
$4.80	$1.01	$5.81

5.4.6 BENEFITS

The majority of the benefits associated with this option are similar to those of Option 1 but with a difference with respect to implementation and financial flexibility. In a contractor-operated program, the contractor is expected to provide the capital outlay for construction and operation of the inspection facilities. The actual implementation time requirement is not expected to be any greater for the contractor than it is for the State. The minor difference is the amount of time required for the State to prepare a Request for Proposal, solicit responses, review bids, and let the contract. However, this time is offset by the time saved by the State because it is not responsible for the acquisition of land and the construction of the facilities. A contractor has the flexibility to add or reduce staff loading according to demand without being encumbered by State Civil Service personnel procedures. Additionally, a

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*The State of Michigan has identified the program funding would be provided under the State of Michigan's Motor Vehicle Highway Fund at a 6 percent interest rate.

Table 5-31.
ANNUALIZED PROGRAM COSTS AND CONSUMER FEE - CONTRACTOR
OPTION 3: CONTRACTOR-OPERATED, IDLE TEST
(1978 DOLLARS)

Category	Cost	Capital Recovery Factor	Annualized Cost
1. Initial implementation costs	634,200	0.2374	150,600
2. Capital costs (construction)			
Land	6,010,800	0.06	360,600
Facility and site improvement	10,241,000	0.0872	893,000
Equipment	11,228,500	0.2374	2,665,600
3. Capital costs (other)			
Land	0	-	0
Facility and site improvement	0	-	0
Equipment	0	-	0
4. Subtotal (Items 1, 2, and 3)			4,069,800
5. Annual operating costs	16,580,000	1	16,580,000
6. Consumer protection costs	0	-	0
7. Subtotal (Items 5 and 6)			16,580,000
8. Overhead & G/A (@ 15.5% on Item 5)			2,569,900
9. Contractor's fee (@ 10% on Items 1, 2, 7, and 8)			2,321,970
TOTAL (Items 4, 7, 8, and 9)			25,541,670

Contractor's share - Consumer Fee = $25,541,670/5,320,000 = $4.80

Table 5-32.
ANNUALIZED PROGRAM COSTS AND CONSUMER FEE - STATE
OPTION 3: CONTRACTOR-OPERATED, IDLE TEST
(1978 DOLLARS)

Category	Cost	Capital Recovery Factor	Annualized Cost
1. Initial implementation costs	335,900	0.2374	79,700
2. Capital costs (construction)			
Land	0	-	0
Facility and site improvement	0	-	0
Equipment	100,000	0.2374	23,700
3. Capital costs (other)			
Land[a]	512,400	0.06	30,700
Facility and site improvement[a]	524,400	0.0872	45,700
Equipment	372,300	0.2374	88,400
4. Subtotal (Items 1, 2, and 3)			268,200
5. Annual operating costs[b]	953,000	1	953,000
6. Consumer protection costs[b]	3,484,300	1	3,484,300
7. Subtotal (Items 5 and 6)			4,437,300
8. G/A (@ 15% on Items 5 and 6)			665,600
9. Total (Items 4, 7, and 8)			5,371,100

State's share consumer fee = $5,371,100/5,320,000 = $1.01

[a] Referee stations impose land and building construction costs

[b] Average over 5 years

contractor may be able to raise capital more quickly, thereby expediting program implementation.

Most of the consumer convenience characteristics of a State-operated program are also applicable to a contractor-operated program because both utilize centralized facilities. Waiting time, however, is more controllable in a contractor-operated program because of the contractor's ability to hire temporary or part-time inspectors to increase vehicle throughput during peak volume periods.

With regard to consumer protection, the state must take a more active role in assuring the accurate operational performance of the contractor's facilities. These assurance measures are discussed in Appendix E.

The flexibility for modification of a contractor program could or could not be equivalent to that of the State program dependent upon the substance of the agreement between the contractor and the State. If the contract is very specifically defined, modifications could be very difficult without financial penalties to the State.

5.5 OPTION 5

The configuration for Option 5 is:

- Private garage-operated
- Idle-mode (manual operation and data collection)
- Without safety and noise inspection

5.5.1 OPTION 5 - DEFINITIONS AND REQUIREMENTS

This option is a private garage-operated network of idle test stations. This option adds the following assumptions:

- All private garages will participate
- Only manual inspection equipment will be installed

This option does not include costs of constructing new facilities. Existing private garages that participate in the I/M program will purchase the necessary testing equipment and the State would assume capital costs of administration, office equipment, quality control equipment, mechanic training, consumer complaint, and vehicle test scheduling.

The basic personnel requirements of an I/M program involve both operations and administration. Operating personnel are those directly involved in performing inspections or providing managerial functions at the inspection site. Administrative personnel are involved in operating support programs such as ancillary programs and quality control, or in providing overall program management and administration. The personnel requirements for Option 5 are shown in Table 5-33.

Referee stations are necessary when the following functions are to be performed:

- Investigate consumer complaint cases that require detailed study to establish the validity of the complaint. The referee station can

Table 5-33.
PERSONNEL REQUIREMENTS
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST

Classification	State Administrative Personnel	Inspection Facility Personnel[a]	Quality Control Personnel	Ancillary Program Personnel	Total
Program manager	1				1
Quality control	1				1
Manager	1				1
Environmental engineer	3		12		15
Statistical analyst	2			1	3
Regional manager					
Facility manager					
Technician			44		44
Secretary/clerk	7		12	3	16
Field investigator				3	3
TOTAL	15		68	7	90

[a] Personnel associated with service centers may vary according to work assignment and business nature

perform a detailed or gross diagnostic evaluation. The complaint can be resolved from the resulting data.

- Develop improved testing practices, improved quality control practices, and correlation studies with relation to the Federal Test Procedures (FTP).

- Develop diagnostic routines to establish repair effectiveness during retesting.

The referee station requirements for Option 5 are shown in Table 5-34. The number of stations have been increased because of more consumer complaints and less sophisticated test equipment being utilized.

5.5.2 INITIAL IMPLEMENTATION AND CAPITAL COSTS (ONE-TIME COSTS)

The implementation costs, construction costs, and the other capital costs for Option 5 are presented in Tables 5-35, 5-36, and 5-37, respectively.

5.5.3 OPERATIONS COST (ON-GOING COSTS)

The operating costs for both the inspection facilities and ancillary programs are presented in Tables 5-38 and 5-39 for the years 1983 through and including 1987.

5.5.4 ANNUALIZED PROGRAM COSTS

The annualized program costs shown in Tables 5-40 and 5-41 include capital recovery of the cost of implementation, construction, and other

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*The State of Michigan has identified the program funding would be provided under the State of Michigan's Motor Vehicle Highway Fund at a 6 percent interest rate.

Table 5-34
REFEREE STATION REQUIREMENTS
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST

LOCATION	NUMBER OF STATIONS	COUNTY SERVED
Kalamazoo	1	Branch Allegan Barry Van Buren Kalamazoo St. Joseph Cass Berrien
Grand Rapids	1	Kent Ottawa Muskegon
Lansing	1	Montcalm Gratiot Ionia Clinton Eaton Ingham Calhoun
Ann Arbor	1	Hillsdale Lenawee Jackson Washtenaw Monroe Livingston
Saginaw	1	Midland Bay Saginaw Tuscola Huron Sanilac Shiawassee
Flint	1	St. Clair Genessee Lapeer
Pontiac	2	Oakland
Mt. Clemans	1	Macomb
Detroit	3	Wayne
TOTAL	12	

Table 5-35
INITIAL IMPLEMENTATION COSTS[a]
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Site selection	0
2. Bid preparation and evaluation	0
3. Facilities design	0
4. Training plan development[a]	3,500
5. Personnel selection	2,200
6. Document preparation	10,000
7. Administrative support	156,000
8. System integration, checkout and certification	7,500
9. Test scheduling development	67,000
TOTAL	246,000

[a] State cost

Table 5-36
CAPITAL COSTS (CONSTRUCTION)
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Land and site improvement	
Land	0
Site improvement	0
2. Facility construction	0
3. Instrumentation[a]	51,856,000
4. Office equipment	0
5. Computer costs	
Hardware	0
Software[b]	100,000
TOTAL	51,956,000

[a] Private Garage Cost - Cost is based on $3,656 per service center. There would be 13,965 service centers in 1987

[b] State cost

Table 5-37.
OTHER CAPITAL COSTS[a]
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Administrative office equipment	12,000
2. Quality control equipment	
Mobile units[b] (ten)	200,800
Referee stations[c] (twelve)	2,544,000
Ccorrelation cars (two)	19,400
3. Consumer complaint (3 complaint inspection cars)	15,000
TOTAL	2,791,200

[a] Cost to the State

[b] Assuming 10 percent of private garages will be randomly selected for quality control inspection per 90 days

[c] Including land cost of $1,024,800 and building cost of $1,048,800

Table 5-38.
OPERATING COSTS
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST
(1978 DOLLARS)

Cost Consideration	1983	1984	1985	1986	1987	Total
1. Facility operation[a]	10,825,800	11,128,900	11,440,500	11,760,800	12,090,100	57,246,100
2. Support[b]						
Administration	320,300	320,300	320,300	320,300	320,300	1,601,500
Data analyses	45,000	45,000	45,000	45,000	45,000	225,000
Training[c]	12,400	12,400	12,400	12,400	12,400	12,400
3. Quality control[b]						
Personnel	1,059,600	1,059,600	1,059,600	1,059,600	1,059,600	5,288,000
Supplies	6,800	6,800	6,800	6,800	6,800	34,000
Maintenance	92,500	92,500	92,500	92,500	92,50o	462,500
TOTAL	12,362,400	12,665,500	12,977,100	13,297,400	13,626,700	64,929,100

[a] Emission inspection was assumed to be 7.5 minutes by one investigator. Thus, facility operation cost = $13.41 x $\frac{7.5}{60}$ x vehicle population x (1 + 0.30), where 0.3 is the stringency factor.

[b] State cost

[c] Number of State employees = 90

Table 5-39.
ANCILLARY PROGRAMS OPERATING COSTS[a]
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Mechanic training	b	b	b	b	b	b
2. Public information	1,242,000	1,276,000	1,311,700	1,348,400	1,386,200	6,564,300
3. Consumer complaint	451,000	451,000	451,000	451,000	451,000	2,255,000
4. Vehicle test schedule	1,720,400	1,720,400	1,720,400	1,720,400	1,720,400	8,602,000
TOTAL	3,413,400	3,447,400	3,483,100	3,519,800	3,557,600	17,421,300

[a] Costs are the same for semi-automated and automated systems

[b] Self-supporting operation

Table 5-40.
ANNUALIZED PROGRAM COSTS AND CONSUMER FEE - STATE
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST

Category	Cost	Capital Recovery Factor	Annualized Cost
1. Initial implementation costs	246,200	0.2374	58,400
2. Capital costs (construction)			
Land	0	-	0
Facility & site improvement	0	-	0
Equipment	100,000	0.2374	23,700
3. Capital costs (other)			
Land[a]	1,024,800	0.06	61,500
Facility & site improvement[a]	1,048,800	0.0874	91,700
Equipment	372,300	0.2374	88,400
4. Subtotal (Items 1, 2, and 3)			323,700
5. Annual operating costs[b]	1,536,600	1	1,536,600
6. Consumer protection costs[b]	3,484,300	1	3,484,300
7. Subtotal (items 5 and 6)			5,020,900
8. G/A (@15% on items 5 & 6)			753,135
TOTAL (items 4, 7, and 8)			6,097,800

Consumer Fee (State share) = \$6,097,800/5,320,000 = \$1.15

[a] Referee station impose land building construction costs

[b] Average over 5 years

Table 5-41.
ANNUALIZED PROGRAM COSTS AND CONSUMER FEE - PRIVATE GARAGE
OPTION 5: PRIVATE GARAGE-OPERATED, IDLE TEST

Category	Cost	Capital Recovery Factor	Annualized Cost
1. Initial implementation costs	0	-	0
2. Capital costs (construction)			
Land	0	-	0
Facility & site improvement	0	-	0
Equipment	51,856,000	0.2374	12,310,600
3. Capital costs (other)			
Land	0	-	0
Facility & site improvement	0	-	0
Equipment	0	-	0
4. Annual operating costs[a]	11,449,200	1	11,449,200
5. Consumer protection costs	0	-	0
TOTAL			23,850,800

Consumer Fee (Private Garage share) = \$23,850,800/5,320,000 = \$4.48

[a] Average over 5 years

capital 6 per cent per annum.* The total annualized cost in 1978 dollars are:

- For state - $ 6,097,800
- For private garage - $23,850,800
- Total - $29,948,600

5.5.5 CONSUMER FEES

The average vehicle owner fee (in 1978 dollars) for Option 5 for an average yearly vehicle population of 5,320,000 over 5 years of program operation is:

- For state - $1.15
- For private garage - $4.48
- Total - $5.63

5.5.6 BENEFITS

The use of private garage-operated decentralized facilities offers many of the same advantages as the contractor-operated approach. In the decentralized approach, however, the State would have the responsibility for the certification of garages, training of inspectors, and quality control. Both the certification of garages and the training of inspectors could be carried out under the existing Michigan Motor Vehicle Repair Act. For quality control, the State would be required to provide one or more "challenge" garages to enable a motorist to obtain an independent inspection to compare results with the private-garage inspections. This would involve acquisition of land, building, equipment, and staff by the State. Even though Michigan's capital investment and staff requirements would be much lower than for a state-operated program, they would be greater than for a contractor-operated option (Option 3).

A decentralized private-garage program offers the greatest convenience to the motorist. Due to the number of garages already in existence, the aggregate traveling time and distance required to take the test would be lowest for all options considered. The most convenient aspect of this option is that the motorist may undergo the initial test, maintenance, repairs, and retest in a single visit to the emissions testing stations. The reduced queueing (waiting) time resulting from the larger total of available testing lanes may be offset by the fact that private garages are not specialized facilities and thus efficiency could be lower.

Consumer protection is an issue of great concern for this option. In contrast to a centralized program, the chances of a consumer receiving one or more inaccurate tests are greater due to the difficulty in achieving uniform testing and calibration enforcement procedures. This problem could be offset in part by the State's deploying a greater number of facility inspectors to perform more frequent quality checks.

A decentralized program is less amenable to modification than a state program. A change in the scope and method of testing could be implemented rather easily by requiring the garages to follow the prescribed procedure, but substitution of equipment could engender major problems due to the reluctance by garage entrepreneurs to invest additional capital if debt on the original equipment is not fully paid.

5.6 OPTION 7

The configuration for Option 7 is:

- State-operated, statistical sample
- Idle-mode (manual testing and data collection)
- Without safety and noise inspection

5.6.1 OPTION 7 - DEFINITIONS AND REQUIREMENTS

This option is a state-administered and operated network of idle test stations. It was assumed that a 5 percent test rate would provide a statistically adequate sample of the in-use vehicle population. This implies that approximately 250,000 vehicles would be sampled every year.

In order to calculate the number of test stations required to test 5 percent of the vehicle population, it was estimated that an inspection team (three technicians) could test 23,000 vehicles per year. This requires that test stations be located in all areas with a vehicle population of 460,000 or greater, and therefore requires three one-lane stations, four two-lane stations, one referee station (located in Detroit), and one mobile unit for quality control checks and backup for the referee station. Driving distance was not considered. This may limit participation from a practical standpoint.

The basic personnel requirements of an I/M program include both operations and administration. Operating personnel are those directly involved in performing inspections or providing managerial functions at the inspection site. Administrative personnel are involved in operating support programs such as ancillary programs and quality control, or in providing overall program management and administration. The personnel requirements for Option 7 are shown in Table 5-42.

Table 5-42.
PERSONNEL REQUIREMENTS
OPTION 7: STATE-OPERATED, IDLE TEST, 5 PERCENT SAMPLE

CLASSIFICATION	PERSONNEL State Administrative	Inspection Facility	Quality Control	Ancillary Program	TOTAL
Program manager	1				1
Quality control manager	1				1
Manager	1				1
Environmental engineer	3		1		4
Statistical analyst	2			1	3
Regional manager					0
Facility manager		7			7
Technician		33	4		37
Secretary/clerk	7	7	1	1	16
Field investigator	—	—	—	1	1
TOTAL	15	47	6	3	71

5.6.2 INITIAL IMPLEMENTATION AND CAPITAL COSTS (ONE-TIME COSTS)

The implementation costs, construction costs, and the other capital costs for Option 7 are presented in Tables 5-43, 5-44, and 5-45, respectively.

Table 5-43. INITIAL IMPLEMENTATION COSTS[a]
OPTION 7: STATE-OPERATED, IDLE TEST, 5 PERCENT SAMPLE
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Site selection	7,800
2. Bid preparation and evaluation	9,300
3. Facilities design	16,000
4. Training plan development	3,500
5. Personnel selection	43,000
6. Document preparation	10,000
7. Administrative support	156,000
8. System integration, checkout and certification	9,500
9. Test scheduling system development	67,000
TOTAL	322,100

[a] All costs were rounded-off to hundreds of dollars.

Table 5-44. CAPITAL COSTS (CONSTRUCTION)
OPTION 7: STATE-OPERATED, IDLE TEST, 5 PERCENT SAMPLE
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Land and site improvement	
Land[a]	433,700
Site improvement	140,600
2. Facility construction	320,400
3. Instrumentation	105,100
4. Office equipment	16,500
5. Computer cost	
Hardware	0
Software	100,000
TOTAL	1,116,300

[a] Assuming all facilities located in submetropolitan urban area.

Table 5-45. CAPITAL COSTS (OTHER)
OPTION 7: STATE-OPERATED, IDLE TEST, 5 PERCENT SAMPLE
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Administrative office equipment	12,000
2. Quality control equipment	
a. Mobile unit (one)	20,100
b. Referee station[a] (one)	212,000
c. Correlation car (one)	9,700
3. Consumer Complaint (1 complaint inspection)	5,000
TOTAL	258,800

[a] Including land cost of $85,400 and building cost of $68,800.

5.6.3 OPERATIONS COST (ON-GOING COSTS)

The operating costs for both the inspection facilities and ancillary programs are presented in Tables 5-46 and 5-47 for the years 1983 through and including 1987.

5.6.4 ANNUALIZED PROGRAM COSTS

The annualized program costs shown in Table 5-48 include capital recovery of the cost of implementation, construction, and other capital using an interest figure of 6 percent per annum.* The total annualized cost in 1978 dollars is $1,808,800.

5.6.5 CONSUMER FEES

The average vehicle owner fee (in 1978 dollars) for Option 7 for an average yearly vehicle population of 250,000 over 5 years of program operation is $7.23. If the consumer fee were to be distributed over the 5,320,000 vehicles owners, the fee would be $0.34 per owner.

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*The State of Michigan has identified the program funding would be provided under the State of Michigan's Motor Vehicle Highway Fund at a 6 percent interest rate.

Table 5-46.
ANNUAL OPERATING COSTS
OPTION 7: STATE-OPERATED, IDLE TEST, 5 PERCENT SAMPLE
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Facility operation						
Personnel	619,500	636,900	654,700	673,000	691,900	3,276,000
Maintenance and miscellaneous costs						
-Facility	52,200	52,200	52,200	52,200	52,200	261,000
-Equipment	11,000	11,000	11,000	11,000	11,00	55,000
2. Support						
Administration	320,300	320,300	320,300	320,300	320,300	1,601,500
Data analyses	45,000	45,000	45,000	45,000	45,000	225,000
Training[a]	9,800	9,800	9,800	9,800	9,800	49,000
3. Quality control costs						
Personnel	92,700	92,700	92,700	92,700	92,700	463,500
Supply	600	600	600	600	600	3,000
Maintenance	9,300	9,300	9,300	9,300	9,300	46,500
TOTAL	1,160,400	1,177,800	1,195,600	1,213,900	1,232,800	5,980,500

[a] Total number of employees - 71

Table 5-47.
ANCILLARY PROGRAMS OPERATING COSTS[a]
OPTION 7: STATE-OPERATED, IDLE STATION, 5 PERCENT SAMPLE
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Mechanic training	b	b	b	b	b	b
2. Public information	62,100	63,800	65,600	67,400	69,400	328,300
3. Consumer complaint	22,300	22,300	22,300	22,300	22,300	111,500
4. Vehicle test	86,000	86,000	86,000	86,000	86,000	430,000
TOTAL	170,400	172,100	173,900	175,700	177,700	869,800

[a] All costs are 5 percent of those items of Option 1

[b] Self-supporting operation

Table 5-48
ANNUALIZED PROGRAM COSTS AND CONSUMER FEE
OPTION 7: STATE-OPERATED, IDLE TEST, 5 PERCENT SAMPLE

Category	Cost	Capital Recovery Factor	Annualized Cost
1. Initial implementation costs	322,100	0.2374	76,500
2. Capital costs (construction)			
Land	433,700	0.06	26,000
Facility & site improvement	461,000	0.0872	40,200
Equipment	221,600	0.2374	52,600
3. Capital costs (other)			
Land	85,400	0.06	5,100
Facility & site improvement	68,800	0.0872	6,000
Equipment	104,600	0.2374	24,800
4. Subtotal (Items 1, 2, and 3)			231,200
5. Annual operating costs[a]	1,196,100	1	1,196,100
6. Consumer protection costs[a]	174,000	1	174,000
7. Subtotal (Items 5 and 6)			1,370,100
8. G/A (@15% on Items 5 & 6)			205,500
TOTAL (items 4, 7, and 8)			1,806,800

Consumer Fee = $1,806,800/250,000 = $7.23

[a] Average over 5 years

5.6.6 BENEFITS

The purpose of this option is to make use of a statistically sampled cross section of the vehicle population to demonstrate to the U.S. EPA that (1) the majority of vehicles on Michigan roads is currently performing to manufacturers specifications, and (2) Michigan motorists tune their cars regularly, especially prior to winter months, thereby achieving the same purpose as a regular I/M program. The qualitative advantages and disadvantages for this option are similar to those for Option 1 with the exception that the U.S. EPA does not recognize this as a viable method of emissions control and will not allow an emission reduction credit for the stated purpose. However, this relatively low-cost random selection approach could, if scientifically structured, provide a data base ample to support the contention that a more expensive mandatory and all-inclusive program is unwarranted and that the projected emission reduction credits for a full-scale program may be fallacious.

5.7 OPTION 9

The configuration for Option 9 is:

- State-operated
- Loaded-mode (automated testing and data processing)
- Without safety and noise inspection

5.7.1 OPTION 9 - DEFINITIONS AND REQUIREMENTS

This option is a state-administered and operated network of loaded-mode test stations. The station requirements,based upon the 1983 LDV vehicle population and the 19,200 LDV effective annual output rate (see Section 3), are shown in Table 5-49. Area types were defined in Section 4.5. Detailed lane analysis by county is presented in Appendix G. Dividing the vehicle population of LDVs for each county in 1983 by the annual effective LDV capacity of an inspection lane determines how many lanes are needed in each county.

Table 5-49. STATION REQUIREMENTS
OPTION 9: STATE-OPERATED, LOADED TEST

Area Type	Single Lane	Double Lane
Metropolitan		
Urban	0	18
Suburban	0	14
Rural	10	0
Submetropolitan		
Urban	0	27
Suburban	34	0
Rural	19	0
Minor metropolitan		
Urban	78	0
Suburban	0	0
TOTAL	141	59

The basic personnel requirements of an I/M program involve both operations and administration. Operating personnel are those directly involved in performing inspections or providing managerial functions at the inspection site.

Administrative personnel are involved in operating support programs such as ancillary programs and quality control, or in providing overall program management and administration. The personnel requirements for Option 9 are shown in Table 5-50.

Referee stations are necessary when any of the following functions are to be performed:

- Investigate consumer complaint cases that require detailed study to establish the validity of the complaint. (The referee station can perform either a detailed or gross diagnostic evaluation. The complaint can be resolved from the resulting data.)

- Develop improved testing practices, improved quality control practices, and correlation studies with relation to the Federal Test Procedures (FTP).

- Provide additional testing capacity for short-term overflow of demand.

- Develop diagnostic routines to establish repair effectiveness during retesting.

The regional office requirements and referee stations for Option 9 are shown in Table 5-51. Regional offices are located in designated test facilities in which the regional manager and secretary are located.

5.7.2 INITIAL IMPLEMENTATION AND CAPITAL COSTS (ONE-TIME COSTS)

The implementation costs, construction costs, and the other capital costs for Option 9 are presented in Tables 5-52, 5-53, and 5-54, respectively.

5.7.3 OPERATIONS COST (ON-GOING COSTS)

The operating costs for both the inspection facilities and ancillary programs are presented in Tables 5-55 and 5-56 for the years 1983 through and including 1987.

Table 5-50.
PERSONNEL REQUIREMENTS
OPTION 9: STATE-OPERATED, LOADED TEST

Classification	State Administrative Personnel	Inspection Facility Personnel	Quality Control Personnel	Ancillary Program Personnel	Total
Program manager	1				1
Quality control	1				1
Manager	1				1
Environmental engineer	3		6		9
Statistical analyst	2			1	3
Regional manager		14			14
Facility manager		200			200
Technician		777	22		799
Secretary/clerk	7	214	6	3	230
Field investigator				3	3
TOTAL	15	1,205	34	7	1,261

Table 5-51
REFEREE AND REGIONAL STATION REQUIREMENTS
OPTION 9: STATE-OPERATED, LOADED TEST

Location	Referee Stations	Referee Offices[a]	County Served
Kalamazoo	-	1	Kalamazoo Berrien Van Buren Cass St. Joseph Allegan Branch
Grand Rapids	-	1	Kent Muskegon
Grand Rapids	1	1	Ottawa Barry Montcalm Gratiot Ionia Clinton Shiawassee
Lansing	1	1	Ingham Eaton Calhoun Jackson
Ann Arbor	1	1	Washtenaw Monroe Livingston Hillsdale Lenawee
Saginaw	-	1	Saginaw Midland Bay Tuscola Huron Sanilac
Flint	1	1	St. Clair Genessee Lapeer
Pontiac	1	2	Oakland (two-lane)
Mt. Clemens	-	1	Macomb (part of one-lane)
Detroit	1	4	Wayne
	6	14	

[a] Regional stations utilize office space in designated inspection facilities for management functions only.

Table 5-52
INITIAL IMPLEMENTATION COSTS
OPTION 9: STATE-OPERATED, LOADED TEST
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Site selection	85,000
2. Bid preparation and evaluation	19,400
3. Facilities design	466,800
4. Training plan development	5,000
5. Personnel selection	43,000
6. Document preparation	10,000
7. Administrative support	156,000
8. System integration, check-out and certification	596,900
9. Test scheduling system development	67,000
TOTAL	1,449,100

Table 5-53. CAPITAL COSTS (CONSTRUCTION)
OPTION 9: STATE-OPERATED, LOADED TEST
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Land snd Site Improvement	
Land	7,242,700
Site improvement	3,720,000
2. Facility construction	9,336,000
3. Instrumentation	6,747,000
4. Office equipment	300,000
5. Computer costs	
Hardware	10,489,500
Software	108,000
TOTAL	37,943,200

Table 5-54.
CAPITAL COSTS (OTHER)
OPTION 9: STATE-OPERATED, LOADED TEST
YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Administrative office equipment	12,000
2. Quality control equipment	
Mobile units (five)	100,400
Referee stations[a]	1,272,000
Correlation car (one)	9,700
3. Consumer complaint (3 complaint inspection cars)	15,000
TOTAL	1,409,100

[a] Including land cost of $512,400 and building cost of $524,400

Table 5-55.
OPERATING COSTS
OPTION 9: STATE-OPERATED, LOADED TEST
(1978 DOLLARS)

Cost Consideration	1983	1984	1985	1986	1987	Total
1. Facility operation						
Personnel	16,133,710	16,585,453	17,049,845	17,527,240	18,018,002	85,314,300
Maintenance and misc. costs						
Facility	1,331,100	1,331,100	1,331,100	1,331,100	1,331,100	6,655,500
Equipment	699,300	699,300	699,300	699,300	699,300	3,496,500
2. Support						
Administration	320,300	320,300	320,300	320,300	320,300	1,601,500
Data analyses	45,000	45,000	45,000	45,000	45,000	225,000
Training	149,200	149,200	149,200	149,200	149,200	746,000
3. Quality control costs						
Personnel	529,800	529,800	529,800	529,800	529,800	2,649,000
Supplies	3,400	3,400	3,400	3,400	3,400	17,000
Maintenance	46,800	46,800	46,800	46,800	46,800	234,000
TOTAL	19,258,610	19,710,353	20,174,745	20,652,140	21,142,902	100,938,800

Table 5-56.
ANCILLARY PROGRAMS OPERATING COSTS
OPTION 9: STATE-OPERATED, LOADED TEST
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Mechanic training	a	a	a	a	a	a
2. Public information	1,242,000	1,276,000	1,311,700	1,348,400	1,386,200	6,564,300
3. Consumer complaint	451,000	451,000	451,000	451,000	451,000	2,255,000
4, Vehicle test schedule	1,720,400	1,720,400	1,720,400	1,720,400	1,720,400	8,602,000
TOTAL	3,413,400	3,447,400	3,483,100	3,519,800	3,557,600	17,421,300

[a] Self-supporting operation

5.7.4 ANNUALIZED PROGRAM COSTS

The annualized program costs shown in Table 5-57 include capital recovery of the cost of implementation, construction, and other capital using an interest figure of 6 percent per annum.* The total annualized cost in 1978 dollars is $33,493,600.

5.7.5 CONSUMER FEES

The average vehicle owner fee (in 1978 dollars) for Option 9 for an average yearly vehicle population of 5,320,000 over 5 years of program operation is $6.30.

5.7.6 BENEFITS

A loaded mode test requires additional equipment, mainly a dynamometer, for complete testing. It takes longer to perform a test, reducing throughput accordingly. The cost of training inspectors is increased three-fold over that for an idle emission test. The major benefit of a loaded mode test is that it is able to provide superior diagnostic information to that of the idle test. The diagnostic test procedure, if accomplished effectively, indicates probable adjustments or repairs that should be performed. This assumes that properly trained mechanics are available. This technique may result in reduced repair costs to the vehicle owner. Additionally, the longevity of engine emissions control performance may be enhanced.

The test procedure includes engine-load modes that tend to stress certain emission-critical components. Components that fail during the stress conditions may be marginal under normal operating conditions. Replacement of these marginal components may preclude subsequent failure and resultant high exhaust emissions. A loaded mode test can measure tailpipe emissions of oxides of nitrogen (NO_x) and could be a valuable tool where there is a NO_x problem.

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*The State of Michigan has identified the program funding would be placed under the State of Michigan's Motor Vehicle Highway Fund at a 6 percent interest rate.

Table 5-57.
ANNUALIZED PROGRAM COSTS AND CONSUMER FEE
OPTION 9: STATE-OPERATED, LOADED TEST

Category	Cost	Capital Recovery Factor	Annualized Cost
1. Initial implementation costs	1,449,100	0.2374	344,000
2. Capital costs (construction)			
Land	7,242,700	0.06	434,600
Facility & site improvement	12,056,000	0.0872	1,138,500
Equipment	17,644,500	0.2374	4,188,800
3. Capital costs (other)			
Land[a]	512,400	0.06	30,700
Facility & site improvement[a]	524,400	0.0872	45,700
Equipment	372,300	0.2374	88,400
4. Subtotal (Items 1, 2, and 3)			6,270,700
5. Annual operating costs	20,187,800	1	20,187,800
6. Consumer protection costs[b]	3,484,300	1	3,484,300
7. Subtotal (Items 5 and 6)			23,672,100
8. G/A (@15% on Items 5 & 6)			3,550,800
TOTAL (items 4, 7, and 8)			33,493,600

Consumer Fee = $33,493,600/5,320,000 = $6.30.

[a] Referee stations impose land and building construction costs

[b] Average over 5 years

5.8 OPTION 17

The configuration for Option 17 is:

- State-operated
- Engine Parameter/Device Inspection (EPDI) (manual testing and data collection)
- Without safety and noise inspection

5.8.1 OPTION 17 - DEFINITIONS AND REQUIREMENTS

This option is a state-administered and operated network of engine parameter/device inspection test stations. The station requirements, based upon the 1983 LDV population and the 4,500 LDV effective annual output rate (see Section 3), are shown in Table 5-58. Area types were defined in Section 4.5. Detailed lane analysis by county is presented in Appendix G. Dividing the vehicle population of LDVs for each county in 1983 by the annual effective LDV capacity of an inspection lane determines how many lanes are needed in each county.

Table 5-58. STATION REQUIREMENTS
OPTION 17: STATE-OPERATED, ENGINE PARAMETER/DEVICE INSPECTION

Area Type	Single Lane	Double Lane
Metropolitan		
Urban	0	80
Suburban	0	73
Rural	12	0
Submetropolitan		
Urban	0	92
Suburban	0	95
Rural	82	0
Minor metropolitan		
Urban	120	38
Suburban	134	0
TOTAL	348	378

The basic personnel requirements of an I/M program involve both operations and administration. Operating personnel are those directly involved in performing inspections or providing managerial functions at the inspection site. Administrative personnel are involved in operating support programs such as ancillary programs and quality control, or in providing overall program management and administration. The personnel requirements for Option 17 are shown in Table 5-59.

Referee stations are necessary when any of the following functions are to be performed:

- Investigate consumer complaint cases that require detailed study to establish the validity of the complaint. (The referee station can perform either a detailed or gross diagnostic evaluation. The complaint can be resolved from the resulting data.)
- Develop improved testing practices, improved quality control practices, and correlation studies with relation to the Federal Test Procedures (FTP).
- Provide additional testing capacity for short-term overflow of demand.
- Develop diagnostic routines to establish repair effectiveness during retesting.

The regional office requirements and referee stations for Option 17 are shown in Table 5-60. Regional offices are located in designated test facilities in which the regional manager and secretary are located.

5.8.2 INITIAL IMPLEMENTATION AND CAPITAL COSTS (ONE-TIME COSTS)

The implementation costs, construction costs, and the other capital costs for Option 17 are presented in Tables 5-61, 5-62, and 5-63, respectively.

5.8.3 OPERATIONS COST (ON-GOING COSTS)

The operating costs for both the inspection facilities and ancillary programs are presented in Tables 5-64 and 5-65 for the years 1983 through and including 1987.

Table 5-59.
PERSONNEL REQUIREMENTS
OPTION 17: STATE-OPERATED, EPDI TEST

Classification	State Administrative Personnel	Inspection Facility Personnel	Quality Control Personnel	Ancillary Program Personnel	Total
Program manager	1				1
Quality control	1				1
Manager	1				1
Environmental engineer	3		6		9
Statistical analyst	2			1	3
Regional manager		60			60
Facility manager		726			726
Technician		3,312	32		3,344
Secretary/clerk	7	786	6	3	802
Field investigator	—	—	—	3	3
TOTAL	15	4,884	44	7	4,950

Table 5-60. REGIONAL STATION REQUIREMENTS
OPTION 17: STATE-OPERATED, EPDI TEST

LOCATION	Referee Stations	Regional[a] Offices	COUNTY SERVED
Kalamazoo	-	2	Kalamazoo Allegan Barry
Benton Harbor	-	2	Berrien Cass Van Buren
Marshall	-	2	Calhoun St. Joseph Branch Hillsdale
Grand Rapids	1	4	Kent Montcalm Ionia
Muskegon	-	2	Muskegon Ottawa
Lansing	1	4	Ingham Clinton Eaton Shiawassee Livingston
Ann Arbor	1	2	Washtenaw
Jackson	-	2	Jackson Lenawee
Saginaw	-	2	Saginaw Gratiot
Bay City	-	2	Bay Tuscola Huron Sanilac Midland
Flint	1	4	Genessee Lapeer
Mt. Clemens	-	6	Macomb St. Clair
Monroe	-	2	Monroe
Detroit	1	16	Wayne
Pontiac	1	8	Oakland
Total	6	60	

[a] Regional stations utilize office space in designated inspection facilities for management functions only.

Table 5-61.
INITIAL IMPLEMENTATION COSTS
OPTION 17: STATE-OPERATED, ENGINE PARAMETER/DEVICE INSPECTION TEST, YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Site selection	295,400
2. Bid preparation and evaluation	14,800
3. Facilities design	
4. Training plan development	7,500
5. Personnel selection	43,000
6. Document preparation	10,000
7. Administrative support	156,000
8. System integration, check-out and certification	1,486,100
9. Test scheduling system development	67,000
TOTAL	2,079,800

Table 5-62.
CAPITAL COSTS (CONSTRUCTION)
OPTION 17: STATE-OPERATED, ENGINE PARAMETER/DEVICE INSPECTION TEST, YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Land and site improvement	
Land	26,307,600
Site improvement	14,486,400
2. Facility construction	26,352,000
3. Instrumentation	17,167,200
4. Office equipment	1,089,000
5. Computer costs	
Hardware	44,712,000
Software	108,000
TOTAL	130,222,200

Table 5-63.
CAPITAL COSTS (OTHER)
OPTION 17: STATE-OPERATED, ENGINE PARAMETER/DEVICE INSPECTION TEST, YEAR - 1982
(1978 DOLLARS)

Cost Elements	Dollars
1. Administrative office equipment	12,000
2. Quality control equipment	
Mobile units (ten)	200,700
Referee stations[a] (six)	1,272,000
Correlation cars (two)	19,400
3. Consumer complaint (3 complaint inspection cars)	15,000
TOTAL	1,519,100

[a] Including land cost of $512,400 and building cost of $524,400

Table 5-64.
OPERATING COSTS
OPTION 17: STATE-OPERATED, ENGINE PARAMETER/DEVICE INSPECTION TEST
(1978 DOLLARS)

Cost Consideration	1983	1984	1985	1986	1987	Total
1. Facility operation						
Personnel	65,381,016	67,211,684	69,093,611	71,028,232	73,017,022	345,731,600
Maintenance and misc. costs						
Facility	5,307,000	5,307,000	5,307,000	5,307,000	5,307,000	26,535,000
Equipment	2,594,400	2,594,400	2,594,400	2,594,400	2,594,400	12,972,000
2. Support						
Administration	320,300	320,300	320,300	320,300	320,300	1,601,500
Data analyses	45,000	45,000	45,000	45,000	45,000	225,000
Training[a]	1,361,300	1,361,300	1,361,300	1,361,300	1,361,300	6,806,500
3. Quality control costs						
Personnel	662,800	662,800	662,800	662,800	662,800	3,314,000
Supplies	4,400	4,400	4,400	4,400	4,400	22,000
Maintenance	65,500	65,500	65,500	65,500	65,500	327,500
TOTAL	75,741,716	77,572,384	79,454,311	81,388,932	83,377,722	397,535,100

[a] Total number of employees 4,950

Table 5-65.
ANCILLARY PROGRAMS OPERATING COSTS
OPTION 17: STATE-OPERATED, ENGINE PARAMETER/DEVICE INSPECTION TEST
(1978 DOLLARS)

Cost Items	1983	1984	1985	1986	1987	Total
1. Mechanic training	a	a	a	a	a	a
2. Public information	1,242,000	1,276,000	1,311,700	1,348,400	1,386,200	6,564,300
3. Consumer complaint	451,000	451,000	451,000	451,000	451,000	2,255,000
4, Vehicle test schedule	1,720,400	1,720,400	1,720,400	1,720,400	1,720,400	8,602,000
TOTAL	3,413,400	3,447,400	3,483,100	3,519,800	3,557,600	17,421,300

[a] Self-supporting operation

5.8.4 ANNUALIZED PROGRAM COSTS

The annualized program costs shown in Table 5-66 include capital recovery of the cost of implementation, construction, and other capital using an interest figure of 6 percent per annum.* The total annualized cost in 1978 dollars is $116,238,500.

5.8.5 CONSUMER FEES

The average vehicle owner fee (in 1978 dollars) for Option 17 for an average yearly vehicle population of 5,320,000 over 5 years of program operation is $21.85.

5.8.6 BENEFITS

The parameter test requires over 12 minutes' time, as opposed to 2 minutes for an idle test, and therefore vehicle throughput rate is decreased dramatically. Because more stations would be needed to accommodate the vehicle population, significantly higher capital and operating costs and inspection fees characterize this option. The major benefit of this method of testing is that it is the test most likely to pinpoint the reason for emissions failure of a vehicle. This capability will be enhanced for vehicles with on-board diagnostic components that will actually be able to "tell" a knowledgeable mechanic what is wrong with the vehicle's operation or performance. This technology is expected to be standard equipment by 1983.

Table 5-66.
ANNUALIZED PROGRAM COSTS AND CONSUMER FEE
OPTION 17: STATE-OPERATED, EPDI TEST

Category	Cost	Capital Recovery Factor	Annualized Cost
1. Initial implementation costs	2,079,800	0.2374	493,700
2. Capital costs (construction)			
Land	26,307,600	0.06	1,578,500
Facility & site improvement	40,838,400	0.0872	3,561,100
Equipment	63,076,200	0.2374	14,974,300
3. Capital costs (other)			
Land[a]	512,400	0.06	30,700
Facility & site improvement[a]	524,400	0.0872	45,700
Equipment	482,300	0.2374	114,500
4. Subtotal (Items 1,2, and 3)			20,798,500
5. Annual Operating Costs	79,507,000	1	79,507,000
6. Consumer protection costs[b]	3,484,300	1	3,484,300
7. Subtotal (Items 5 thru 6)			82,991,300
8. G/A (@15% on Items 5 & 6)			12,448,700
TOTAL (Items 4, 7, and 8)			116,238,500

Consumer Fee = $116,238,500/5,320,000 = $21.85

[a] Referee stations impose land and building construction costs

[b] Average over 5 years

5.9 LIGHT-DUTY TRUCKS

The previous option analyses did not consider inpsection of light-duty trucks (LDT_1) less than 6,001 pounds gross vehicle weight. In 1983 there would be 756,264 LDT's and 4,967,970 passenger vehicles for a total of 5,724,234 light-duty vehicles. This would increase the number of vehicles to be tested in the nonattainment areas by over 15 percent.

Extrapolating the average passenger vehicle population from 1983 to 1987, assuming a 2.8 percent per year vehicle growth, yields 5,320,000 vehicles. With the inclusion of similarly extrapolated LDT_1, the average number of vehicles inspected would increase to 6,129,852.

Table 5-67 presents comparisons for each of the seven base options for light-duty vehicles with and without LDT_1's. As shown, consumer fees decrease by 2 cents maximum and in two cases remain the same. The analysis was based upon recalculating the capital and annual operating costs. Where cost elements are affected by increasing the number of inspections, a 15.223 percent factor was applied. If a cost element was insensitive to additional vehicles in the program, cost by program option remained the same as for the original computation. The cost element sensitivity is similar to that of geographic area of coverage, presented in Section 6.

Table 5-67. COST COMPARISON OF SEVEN I/M PROGRAM BASE OPTIONS WITH AND WITHOUT LDT_1 (IN 1978 DOLLARS)

PROGRAM OPTION	INITIAL IMPLEMENTATION AND CAPITAL COSTS	ANNUAL OPERATING COSTS[a]	ANNUAL ANCILLARY PROGRAM OPERATING COSTS[a]	5-YEAR TOTAL PROGRAM COSTS	CONSUMER FEE
1. State-operated, idle test without safety and noise inspection					
a. passenger vehicles	29,959,500	17,337,000	3,848,300	141,413,100	$ 5.32
b. with LDT_1	34,254,300	25,835,200	4,014,700	162,436,300	$ 5.30
2. State-operated, idle test with safety and noise inspection					
a. passenger vehicles	36,585,500	24,247,700	3,484,300	187,098,500	$ 7.04
b. with LDT_1	41,889,700	27,883,400	4,014,700	215,060,700	$ 7.02
3. Contractor-operated, idle t4est without safety and noise inspection					
a. passenger vehicles	29,959,500	17,533,000	3,484,300	154,563,900	$ 5.81
b. with LDT_1	34,254,300	25,835,200	4,014,700	177,542,200	$ 5.79
5. Private garage-operated, idle test without safety and noise inspection					
a. passenger vehicles	54,648,600	12,985,800	3,484,300	149,743,000	$ 5.63
b. with LDT_1	62,967,800	14,962,600	4,014,700	172,538,400	$ 5.63
7. Statistical sampling, idle test without safety and noise inspection					
a. passenger vehicles	1,697,200	1,196,100	174,000	9,034,000	$ 7.23
b. with LDT_1	1,697,200	1,196,100	174,000	9,034,000	$ 7.23
9. State-operated loaded test without safety and noise inspection					
a. passenger vehicles	40,801,400	20,187,800	3,484,300	167,468,000	$ 6.30
b. with LDT_1	46,746,600	23,206,500	4,014,700	192,370,000	$ 6.28
17. State-operated, engine parameter/device inspection without safety and noise inspection					
a. passenger vehicles	133,821,100	79,507,000	3,484,300	581,192,500	$21.85
b. with LDT_1	153,910,300	91,554,700	3,014,700	669,053,100	$21.83

[a] Does not include State G/A (15%) nor contractor overhead, G/A, and profit.

Section 6

COMPARATIVE ANALYSES OF I/M OPTIONS

This section presents a comparison of the 24 major I/M program options and identifies the interrelated sensitivities of options. Sensitivity analysis was performed on all major cost related variables. The sensitivity analysis provides information with respect to the effect of including or excluding various program considerations. The major variables used in the sensitivity analysis are:

- Three test modes: idle, loaded, and engine parameter/device inspection (EPDI)
- Six geographic areas: nonattainment area, Statewide, Detroit, Grand Rapids, Flint, and Lansing.
- Number of lanes: one to six
- Stringency factor - 10 to 50 percent.
- Administrative methods: centralized (State or contractor), decentralized (private garages), and statistical sample.
- Statistical sample size variation: 5 to 25 percent.
- Vehicle type: LDV, LDT_2, HDG, HDD, motorcycles

In addition, there are numerous minor variations which may affect the cost and operation of an I/M program. These relate to equipment selection, personnel efficiency, land cost variation, etc. Such variations were not analyzed as they are beyond the scope of this study.

6.1 COST COMPARISON OF 24 MAJOR I/M PROGRAM OPTIONS

In Section 5, seven of the 24 options were analyzed in detail. The remaining 17 options are analyzed in this section in terms of their initial implementation and capital costs, average annual operating costs, and ancillary program operating costs. Furthermore, 5-year total program costs and consumer fees are estimated.

By using the given seven options as bases, the cost methodology of estimating the remaining 17 options is defined as follows. First, the appropriate cost ratio is found among base options, defined by administrative option, method of test, and the associated program (safety and noise inspection). Second, the cost ratio is applied to the candidate option by multiplying it by the cost of the given base within the same option group. For example, in order to estimate cost of Option 11, determine the cost ratio between Options 9 and 1. Then, this factor will be multiplied by the cost of Option 3. (See Table 5-1.)

In addition to three direct cost categories, the 5-year total program costs of the 17 options include appropriate G/A, overhead, and profit as assumed in Section 3. However, interest incurred by initial implementation and capital costs is neglected for ease of computation and lack of detailed information on land value, building costs, etc. Consumer fee, as usual, is the average fee per vehicle based on the annualized program costs. Results are presented in Table 6-1.

Among the 24 options, those which are either state-operated or contractor-operated have automated inspection systems. Options with either private garage operation or statistical sampling have manual inspection systems. They are considered as normal configurations. Consumer fee ranges from approximately $5 to $44 among options. Options with engine parameter/device inspection are considered to be "expensive," since the inspection time is approximately 10 times that of the other two test methods.

Table 6-1. COST COMPARISON OF 24 I/M PROGRAM OPTIONS
(In 1978 Dollars)

PROGRAM OPTIONS	INITIAL IMPLEMENTATION AND CAPITAL COSTS	ANNUAL OPERATING COSTS[b]	ANNUAL ANCILLARY PROGRAM OPERATING COSTS[b]	5-YEAR TOTAL PROGRAM COSTS	CONSUMER FEE
1. State-operated, idle test without safety and noise inspection[a]	29,959,500	17,337,000	3,484,300	141,413,100	$ 5.32
2. State-operated, idle test with safety and noise inspection[a]	36,585,500	24,247,700	3,484,300	187,098,500	$ 7.04
3. Contractor-operated, idle test without safety and noise inspection[a]					
o state	1,845,000	953,000	3,484,300	26,855,500	$ 1.01
o contractor	28,114,500	16,580,000	0	127,708,400	+ $ 4.80
Total	29,959,500	17,533,000	3,484,300	154,563,900	= $ 5.81
4. Contractor-operated, idle test with safety and noise inspection					
o state	1,845,000	953,000	3,484,300	26,855,500	$ 1.01
o contractor	34,740,500	23,329,900	0	215,288,500	+ $ 8.09
Total	36,585,500	24,282,900	3,484,300	242,144,000	= $ 9.10

Table 6-1 (Continued)

PROGRAM OPTIONS	INITIAL IMPLEMENTATION AND CAPITAL COSTS	ANNUAL OPERATING COSTS[b]	ANNUAL ANCILLARY PROGRAM OPERATING COSTS[b]	5-YEAR TOTAL PROGRAM COSTS	CONSUMER FEE
5. Private garage-operated, idle test without safety and noise inspection[a]					
o state	2,792,100	1,536,600	3,484,300	30,489,000	$ 1.15
o service center	51,856,000	11,449,200	0	119,254,000	+ $ 4.48
Total	54,648,100	12,985,800	3,484,300	148,743,000	= $ 5.63
6. Private garage-operated, idle test with safety and noise inspection					
o state	2,792,100	1,536,600	3,484,300	30,489,000	$ 1.15
o service center	63,324,700	16,028,900	0	143,469,200	+ $ 5.39
Total	66,116,800	17,565,500	3,484,300	173,958,200	= $ 6.54
7. Statistical sampling, idle test without safety and noise inspection[a]	1,697,200	1,196,100	174,000	9,034,000	$ 7.23
8. Statistical sampling, idle test with safety and noise inspection	2,072,600	1,669,200	174,000	12,671,000	$10.14

Table 6-1. (Continued)

PROGRAM OPTIONS	INITIAL IMPLEMENTATION AND CAPITAL COSTS	ANNUAL OPERATING COSTS[b]	ANNUAL ANCILLARY PROGRAM OPERATING COSTS[b]	5-YEAR TOTAL PROGRAM COSTS	CONSUMER FEE
9. State-operated, loaded test without safety and noise inspection[a]	40,801,400	20,187,800	3,484,300	167,468,000	$ 6.30
10. State-operated, loaded test with safety and noise inspection	49,771,700	27,995,000	3,484,300	230,777,500	$ 8.68
11. Contractor-operated, loaded test without safety and noise inspection					
o state	1,845,000	953,000	3,484,300	26,855,500	$ 1.01
o contractor	38,956,400	19,043,400	0	187,391,400	+ $ 7.04
Total	40,801,400	19,996,400	3,484,300	214,246,900	= $ 8.05
12. Contractor-operated, loaded test with safety and noise inspection					
o state	1,845,000	953,000	3,484,300	26,855,500	$ 1.01
o contractor	47,926,700	27,042,000	0	257,968,200	+ $ 9.70
Total	49,771,700	27,995,000	3,484,300	284,823,700	= $10.71

Table 6-1. (Continued)

PROGRAM OPTIONS	INITIAL IMPLEMENTATION AND CAPITAL COSTS	ANNUAL OPERATING COSTS[b]	ANNUAL ANCILLARY PROGRAM OPERATING COSTS[b]	5-YEAR TOTAL PROGRAM COSTS	CONSUMER FEE
13. Private garage-operated, loaded test without safety and noise inspection					
o state	2,792,100	1,536,600	3,484,300	30,489,000	$ 1.15
o service center	70,621,900	13,321,900	0	137,231,400 +	$ 5.15
Total	73,414,000	14,858,500	3,484,300	167,720,400 =	$ 6.30
14. Private garage-operated, loaded test with safety and noise inspection					
o state	2,792,100	1,536,600	3,484,300	30,489,000	$ 1.15
o service center	86,148,300	18,650,700	0	179,401,800 +	$ 6.74
Total	88,940,400	20,187,300	3,484,300	209,890,800 =	$ 7.89
15. Statistical sampling, loaded test without safety and noise inspection	2,308,200	1,387,300	174,000	11,285,700	$ 9.03
16. Statistical sampling, loaded test with safety and noise inspection	2,815,700	1,942,200	174,000	14,983,900	$11.98

Table 6-1. (Continued)

PROGRAM OPTIONS	INITIAL IMPLEMENTATION AND CAPITAL COSTS	ANNUAL OPERATING COSTS[b]	ANNUAL ANCILLARY PROGRAM OPERATING COSTS[b]	5-YEAR TOTAL PROGRAM COSTS	CONSUMER FEE
17. State-operated, engine parameter/device inspection without safety and noise inspection[a]	133,821,100	79,507,000	3,484,300	581,192,500	$21.85
18. State-operated, engine parameter/device inspection with safety and noise inspection	163,261,700	110,656,100	3,484,300	819,569,000	$30.81
19. Contractor-operated, engine parameter/device inspection without safety and noise inspection					
o state	1,845,000	953,000	3,484,300	26,855,500	$ 1.01
o contractor	131,976,100	78,087,100	0	737,498,100 +	$27.73
Total	133,821,100	79,040,100	3,484,300	764,353,600 =	$28.74
20. Contractor-operated, engine parameter/device inspection with safety and noise inspection					
o state	1,845,000	953,000	3,484,300	26,855,500	$ 1.01
o contractor	161,416,700	109,703,100	0	1,010,204,900 +	$37.98
Total	163,261,700	110,656,100	3,484,300	1,037,060,400 =	$38.99

Table 6-1. (Concluded)

PROGRAM OPTIONS	INITIAL IMPLEMENTATION AND CAPITAL COSTS	ANNUAL OPERATING COSTS[b]	ANNUAL ANCILLARY PROGRAM OPERATING COSTS[b]	5-YEAR TOTAL PROGRAM COSTS	CONSUMER FEE
21. Private garage-operated, engine parameter/device inspection without safety and noise inspection					
o state	2,792,100	1,536,600	3,484,000	30,489,000	$ 1.15
o service center	231,626,900	52,659,000	0	494,921,900	+ $18.61
Total	234,419,000	54,185,600	3,484,000	525,410,900	= $19.76
22. Private garage-operated, engine parameter/device inspection with safety and noise inspection					
o state	2,792,100	1,536,600	3,484,000	30,489,000	$ 1.15
o service center	282,584,800	73,722,600	0	651,197,800	+ $24.48
Total	285,376,900	75,259,200	3,484,000	681,686,800	= $25.63
23. Statistical sampling, engine parameter/device inspection without safety and noise inspection	7,581,100	5,483,600	174,000	40,112,300	$32.09
24. Statistical sampling, engine parameter/device inspection with safety and noise inspection	9,248,900	7,677,000	174,000	54,392,200	$43.50

[a] These options were analyzed in detail in Section 5.

[b] Does not include State G/A (15%) nor contractor overhead, G/A, and profit.

The State's share of program cost when the State does not perform the inspections, $1.01 to $1.16 per vehicle per year, exhibits little change among options. Major State costs in this case are for program planning, administration, and quality control. These cost items do not vary significantly from one program option to another.

6.2 TEST MODE SENSITIVITY

The test mode sensitivity is obtained by comparing Options 1, 9, and 17, which vary only with respect to the test mode. The major cost variations are those which are sensitive to output rate (such as numbers of stations, operating personnel, quality control personnel, and equipment). No ratio table is presented here because a detailed cost analysis of these three options was performed in Section 5. Refer to tables under each of the option discussions to determine which cost parameters are most sensitive to test mode.

6.3 AREA COVERAGE SENSITIVITY

The area coverage sensitivity is presented in Table 6-2. The variations are caused by the number of vehicles tested. In addition, the construction requirements would be impacted because of the need to provide facilities convenient to the user. This may require the construction of single-lane facilities in lieu of double-lane or larger facilities. In most cases, the sensitivity factors are obtained by:

$$\frac{\text{Number of vehicles in area of coverage}}{\text{Number of vehicles in nonattainment area}}$$

The variations in Table 6-2 are referenced to the 38-county nonattainment area of the State as a base. Where a cost does not vary from one area to another area the corresponding cost sensitivity factor would be one.

TABLE 6-2. I/M PROGRAM COST SENSITIVITIES BY GEOGRAPHIC AREA OF COVERAGE

ITEM	COST ELEMENT	NONATTAINMENT COUNTIES (BASE)	STATEWIDE (FACTOR)	DETROIT (FACTOR)	GRAND RAPIDS (FACTOR)	FLINT (FACTOR)	LANSING (FACTOR)
I.	INITIAL IMPLEMENTATION AND CAPITAL COSTS						
	A. Initial Implementation Costs						
	1. Site selection	1.0	1.082	0.55	0.073	0.055	0.046
	2. Bids preparation and evaluation	1.0	1.0	1.0	0.75	0.75	0.75
	3. Facilities design	1.0	1.082	0.55	0.073	0.055	0.046
	4. Training plan development	1.0	1.0	1.0	1.0	1.0	1.0
	5. Personnel selection	1.0	1.082	0.55	0.073	0.055	0.046
	6. Document preparation	1.0	1.0	1.0	1.0	1.0	1.0
	7. Administrative support	1.0	1.0	1.0	1.0	1.0	1.0
	8. System integration, checkout, and certification	1.0	1.082	0.55	0.073	0.055	0.046
	9. Test scheduling system development	1.0	1.0	1.0	1.0	1.0	1.0
	B. Capital Costs (Construction)						
	1. Land and site improvement cost	1.0	1.082	0.55	0.073	0.055	0.046
	Land costs						
	site improvement costs						
	2. Facility construction	1.0	1.082	0.55	0.073	0.055	0.046
	3. Instrumentation cost	1.0	1.082	0.55	0.073	0.055	0.046
	4. Office equipment	1.0	1.082	0.55	0.073	0.055	0.046
	5. Computer costs						
	Hardware	1.0	1.082	0.55	0.073	0.055	0.046
	Software	1.0	1.0	1.0	1.0	1.0	1.0
	C. Capital Costs (Other)						
	1. Administrative office equipment	1.0	1.0	1.0	1.0	1.0	1.0
	2. Quality control equipment	1.0	1.082	0.55	0.073	0.055	0.046
	3. Consumer complaint	1.0	1.0	0.67	0.33	0.33	0.33

TABLE 6-2. (Continued)

ITEM	COST ELEMENT	NONATTAINMENT COUNTIES (BASE)	STATEWIDE (FACTOR)	DETROIT (FACTOR)	GRAND RAPIDS (FACTOR)	FLINT (FACTOR)	LANSING (FACTOR)
II.	ANNUAL OPERATING COSTS						
	A. Facility Operating Costs						
	1. Personnel costs	1.0	1.082	0.55	0.073	0.055	0.046
	2. Maintenance and miscellaneous	1.0	1.082	0.55	0.073	0.055	0.046
	Facility						
	Equipment						
	B. Support Costs						
	1. Administrative	1.0	1.0	1.0	1.0	1.0	1.0
	2. Data analysis	1.0	1.0	1.0	1.0	1.0	1.0
	3. Training	1.0	1.082	0.55	0.073	0.055	0.046
	C. Quality Control Operating Costs						
	1. Personnel	1.0	1.082	0.55	0.25	0.25	0.25
	2. Supply	1.0	1.082	0.55	0.25	0.25	0.25
	3. Maintenance	1.0	1.082	0.55	0.25	0.25	0.25
III.	ANCILLARY PROGRAMS ANNUAL OPERATING COSTS						
	A. Ancillary Programs Costs						
	1. Mechanic training	1.0	1.082	0.55	0.073	0.055	0.046
	2. Public information program	1.0	1.082	0.55	0.073	0.055	0.046
	3. Consumer complaint	1.0	1.082	0.55	0.073	0.055	0.046
	4. Vehicle test scheduling costs	1.0	1.082	0.55	0.073	0.055	0.046

6.4 FACILITY COST SENSTIVITY

Facility cost multipliers, as they relate to the number of lanes per facility, are presented in Table 6-3. The major variations are those costs that are sensitive to station size. Increasing the number of lanes in a station will result in increased parking space demand, queueing hold area, and testing area.

The relative cost factors shown in Table 6-3 are compared to a double-lane facility. For those cases where the factors are not proportional to the double-lane configuration, a first order estimation was made based upon SCI's engineering judgement and data related to I/M program experiences.

Ancillary program operating costs are related to vehicle population. These costs remain unchanged with respect to the number of lanes per inspection facility.

6.5 STRINGENCY FACTOR SENSITIVITY - 10 TO 50 PERCENT

The stringency factor sensitivity is presented in Table 6-4. The major costs are for construction and operation. The construction and operating costs would be affected in accordance with the increase or decrease in testing vehicles. The sensitivity factors are normalized around a 30 percent stringency factor, and the stringency factor selected is usually less than 50 percent. A 1972 EPA study showed that the aggregate emission reduction benefit is reduced above that level, as shown in Figure 6-1. Data from existing I/M studies indicate that repairs made to marginal failures result in improper adjustment and increased emissions.

TABLE 6-3. I/M FACILITY SENSITIVITIES BY NUMBER OF LANES

ITEM	COST ELEMENT	SINGLE (FACTOR)	DOUBLE (BASE)	THREE (FACTOR)	FOUR (FACTOR)	FIVE (FACTOR)	SIX (FACTOR)
I.	INITIAL IMPLEMENTATION AND CAPITAL COSTS						
	A. Initial Implementation Costs						
	1. Site selection	2.0	1.0	0.67	0.5	0.4	0.33
	2. Bids preparation and evaluation	1.0	1.0	1.0	1.0	1.0	1.0
	3. Facilities design	0.9	1.0	1.1	1.2	1.25	1.3
	4. Training plan development	1.0	1.0	1.0	1.0	1.0	1.0
	5. Personnel selection	1.0	1.0	1.0	1.0	1.0	1.0
	6. Document preparation	1.0	1.0	1.0	1.0	1.0	1.0
	7. Administrative support	1.0	1.0	1.0	1.0	1.0	1.0
	8. System integration, checkout, and certification	0.5	1.0	1.5	2.0	2.5	3.0
	9. Test scheduling system development	1.0	1.0	1.0	1.0	1.0	1.0
	B. Capital Costs (Construction)						
	1. Land and site improvement cost	0.85	1.0	1.15	1.3	1.45	1.6
	Land cost						
	Site improvement costs						
	2. Facility construction	0.8	1.0	1.25	1.50	1.75	2.0
	3. Instrumentation cost	0.5	1.0	1.5	2.0	2.5	3.0
	4. Office equipment	1.0	1.0	1.2	1.3	1.4	1.5
	5. Computer costs						
	Hardware	1.0	1.0	1.0	1.0	1.0	1.0
	Software	1.0	1.0	1.0	1.0	1.0	1.0
	C. Capital Costs (Other)						
	1. Administrative office equipment	1.0	1.0	1.0	1.0	1.0	1.0
	2. Quality control equipment	1.75	1.0	0.8	0.7	0.65	0.6
	3. Consumer complaint	1.0	1.0	1.0	1.0	1.0	1.0

TABLE 6-3. (Continued)

ITEM	COST ELEMENT	SINGLE (FACTOR)	DOUBLE (BASE)	THREE (FACTOR)	FOUR (FACTOR)	FIVE (FACTOR)	SIX (FACTOR)
II.	ANNUAL OPERATING COSTS						
	A. Facility Operating Costs						
	1. Personnel costs	0.625	1.0	1.5	1.875	2.25	2.75
	2. Maintenance and miscellaneous	0.625	1.0	1.5	1.875	2.25	2.75
	Facility						
	Equipment						
	B. Support Costs						
	1. Administrative	1.0	1.0	1.0	1.0	1.0	1.0
	2. Data analysis	1.0	1.0	1.0	1.0	1.0	1.0
	3. Training	1.0	1.0	1.0	1.0	1.0	1.0
	C. Quality Control Operating Costs						
	1. Personnel	1.75	1.0	0.8	0.7	0.65	0.6
	2. Supply	1.75	1.0	0.8	0.7	0.65	0.6
	3. Maintenance	1.75	1.0	0.8	0.7	0.65	0.6
III.	ANCILLARY PROGRAMS ANNUAL OPERATING COSTS						
	A. Ancillary Programs Costs						
	1. Mechanic training	1.0	1.0	1.0	1.0	1.0	1.0
	2. Public information program	1.0	1.0	1.0	1.0	1.0	1.0
	3. Consumer complaint	1.0	1.0	1.0	1.0	1.0	1.0
	4. Vehicle test scheduling costs	1.0	1.0	1.0	1.0	1.0	1.0

TABLE 6-4. I/M PROGRAM SENSITIVITIES BY STRINGENCY FACTOR

ITEM	COST ELEMENT	10% (FACTOR)	20% (FACTOR)	30% (BASE)	40% (FACTOR)	50% (FACTOR)
I.	INITIAL IMPLEMENTATION AND CAPITAL COSTS					
	A. Initial Implementation Costs					
	1. Site selection	0.85	0.92	1.0	1.08	1.15
	2. Bids preparation and evaluation	1.0	1.0	1.0	1.0	1.0
	3. Facilities design	1.0	1.0	1.0	1.0	1.0
	4. Training plan development	1.0	1.0	1.0	1.0	1.0
	5. Personnel selection	1.0	1.0	1.0	1.0	1.0
	6. Document preparation	1.0	1.0	1.0	1.0	1.0
	7. Administrative support	1.0	1.0	1.0	1.0	1.0
	8. System integration, checkout, and certification	0.85	0.92	1.0	1.08	1.15
	9. Test scheduling system development	1.0	1.0	1.0	1.0	1.0
	B. Capital Costs (Construction)					
	1. Land and site improvement cost	0.85	0.92	1.0	1.08	1.15
	Land cost					
	Site improvement costs					
	2. Facility construction	0.85	0.92	1.0	1.08	1.15
	3. Instrumentation cost	0.85	0.92	1.0	1.08	1.15
	4. Office equipment	0.85	0.92	1.0	1.08	1.15
	5. Computer costs					
	Hardware	0.85	0.92	1.0	1.08	1.15
	Software	0.85	0.92	1.0	1.08	1.15
	C. Capital Costs (Other)					
	1. Administrative office equipment	1.0	1.0	1.0	1.0	1.0
	2. Quality control equipment	0.85	0.92	1.0	1.08	1.15
	3. Consumer complaint	1.0	1.0	1.0	1.0	1.0

TABLE 6-4. (Continued)

ITEM	COST ELEMENT	10% (FACTOR)	20% (FACTOR)	30% (BASE)	40% (FACTOR)	50% (FACTOR)
II.	ANNUAL OPERATING COSTS					
	A. Facility Operating Costs					
	1. Personnel costs	0.85	0.92	1.0	1.08	1.15
	2. Maintenance and miscellaneous	0.85	0.92	1.0	1.08	1.15
	Facility					
	Equipment					
	B. Support Costs					
	1. Administrative	1.0	1.0	1.0	1.0	1.0
	2. Data analysis	1.0	1.0	1.0	1.0	1.0
	3. Training	0.85	0.92	1.0	1.08	1.15
	C. Quality Control Operating Costs					
	1. Personnel	0.85	0.92	1.0	1.08	1.15
	2. Supply	0.85	0.92	1.0	1.08	1.15
	3. Maintenance	0.85	0.92	1.0	1.08	1.15
III.	ANCILLARY PROGRAMS ANNUAL OPERATING COSTS					
	A. Ancillary Programs Costs					
	1. Mechanic training	0.85	0.92	1.0	1.08	1.15
	2. Public information program	1.0	1.0	1.0	1.0	1.0
	3. Consumer complaint	0.85	0.92	1.0	1.08	1.15
	4. Vehicle test scheduling costs	1.0	1.0	1.0	1.0	1.0

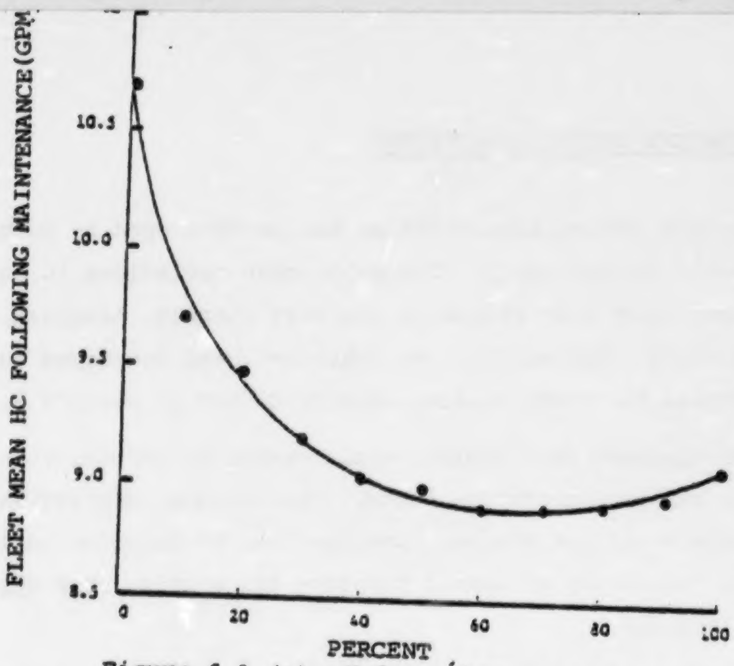

Figure 6.1.(a). Hydrocarbon Reduction vs. Vehicle Rejection Rate

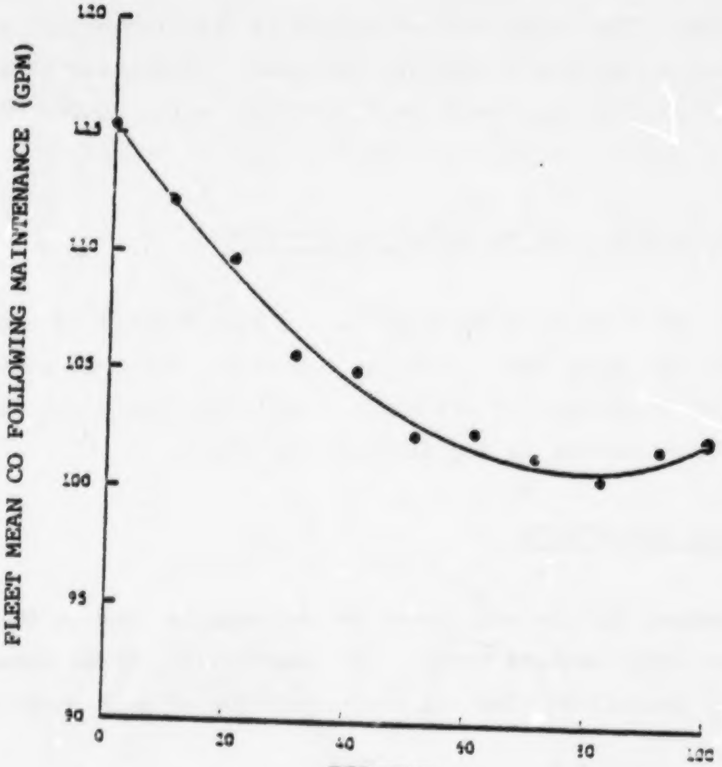

Figure 6.1.(b). Carbon Monoxide Reduction vs. Vehicle Rejection Rate

Source: U.S. EPA "Control Strategies for In-Use Vehicle,"November 1972.

6.6 ADMINISTRATIVE OPTION SENSITIVITY

The administrative option sensitivities can be developed by comparing Options 1, 3, 5, and 7 in Section 5. The major cost variations in the administrative options are those that relate to the test station, overhead, general and administrative costs, and profit. No table has been developed because detailed cost summaries for these options were presented in Section 5.

The contractor-operated test station would result in reduced State operating, construction, and implementation costs. The consumer protection and quality control costs would not change. Another item to consider is property tax. The contractor would pay an annual property tax varying from approximately $1,500 per 2-lane facility.

The private garage option operating costs are less because of the higher State salary rate and benefits as compared to the lower rates of private garage personnel and the lower overhead costs. However, the private garage has longer throughput times. The major cost reduction is the elimination of construction cost because existing stations are utilized. Offsetting this reduction is the increase in total equipment costs to outfit the larger number of participating stations.

6.7 STATISTICAL SAMPLE SIZE VARIATION SENSITIVITY

The statistical sample size sensitivity is directly related to the size of the sample, except in the State administrative activity. For this activity, fixed cost consists of 75 percent of the base. All other costs increase in direct proportion to an increase in the size of the sample.

6.8 VEHICLE TYPE SENSITIVITY

Light-duty passenger vehicle was chosen as the vehicle type in the base analysis. To include other vehicle types, cost sensitivity can be determined by examining per-vehicle inspection time and the population of each vehicle type.

Table 6-5 presents normalized factors for other vehicle types with respect to passenger LDV. The factors are on a vehicle unit basis. Thus, to obtain total cost for each cost category, multiply the normalized factor by the cost of passenger LDV and the ratio of vehicle population. This relationship is expressed as:

$$C_{ij} = C_{bj} \times NF_j \times \frac{VP_i}{VP_b}$$

Where i = vehicle type

b = base type (=LDV)

j = cost item

C_{ij} = cost item j of vehicle type i

C_{bj} = cost item j of base vehicle type

NF_j = normalized factor of cost item j

VP_i = population of vehicle type i

VP_b = population of base vehicle type.

TABLE 6-5. I/M PROGRAM SENSITIVITIES BY VEHICLE TYPE PER VEHICLE

ITEM	COST ELEMENT	LDV (BASE)	LDT$_2$ (FACTOR)	HDG (FACTOR)	HDD (FACTOR)	MC (FACTOR)
I.	INITIAL IMPLEMENTATION AND CAPITAL COSTS					
	A. Initial Implementation Costs					
	1. Site selection	1.0	1.0	1.3	1.3	1.0
	2. Bids preparation and evaluation	1.0	1.0	1.2	1.2	1.2
	3. Facilities design	1.0	1.0	1.3	1.3	1.0
	4. Training plan development	1.0	1.0	1.3	1.3	1.2
	5. Personnel selection	1.0	1.0	1.0	1.0	1.0
	6. Document preparation	1.0	1.0	1.0	1.0	1.0
	7. Administrative support	1.0	1.0	1.0	1.0	1.0
	8. System integration, checkout, and certification	1.0	1.0	1.3	1.3	1.2
	9. Test scheduling system development	1.0	1.0	1.0	1.0	1.0
	B. Capital Costs (Construction)					
	1. Land and site improvement cost	1.0	1.0	1.5	1.5	1.0
	Land cost					
	Site improvement costs					
	2. Facility construction	1.0	1.0	1.5	1.5	1.0
	3. Instrumentation cost	1.0	1.0	1.5	1.5	1.0
	4. Office equipment	1.0	1.0	1.0	1.0	1.0
	5. Computer costs					
	Hardware	1.0	1.0	1.1	1.1	1.1
	Software	1.0	1.0	1.1	1.1	1.1
	C. Capital Costs (Other)					
	1. Administrative office equipment	1.0	1.0	1.0	1.0	1.0
	2. Quality control equipment	1.0	1.0	1.2	1.2	1.1
	3. Consumer complaint	1.0	1.0	1.0	1.0	1.0

TABLE 6-5. (Continued)

ITEM	COST ELEMENT	LDV (BASE)	LDT$_2$ (FACTOR)	HDG (FACTOR)	HDD (FACTOR)	MC (FACTOR)
II.	ANNUAL OPERATING COSTS					
	A. Facility Operating Costs					
	1. Personnel costs	1.0	1.0	1.0	1.0	1.0
	2. Maintenance and miscellaneous Facility Equipment	1.0	1.0	1.5	1.5	1.0
	B. Support Costs					
	1. Administrative	1.0	1.0	1.0	1.0	1.0
	2. Data analysis	1.0	1.0	1.0	1.0	1.0
	3. Training	1.0	1.0	1.1	1.2	1.1
	C. Quality Control Operating Costs					
	1. Personnel	1.0	1.0	1.0	1.0	1.0
	2. Supply	1.0	1.0	1.0	1.0	1.0
	3. Maintenance	1.0	1.0	1.0	1.0	1.0
III.	ANCILLARY PROGRAMS ANNUAL OPERATING COSTS					
	A. Ancillary Programs Costs					
	1. Mechanic training	1.0	1.0	1.0	1.0	1.0
	2. Public information program	1.0	1.0	1.0	1.0	1.0
	3. Consumer complaint	1.0	1.0	1.0	1.0	1.0
	4. Vehicle test scheduling costs	1.0	1.0	1.0	1.0	1.0

Section 7

ISSUE IDENTIFICATION AND OPTION ELIMINATION

The purpose of this section is to describe the factors that were considered in arriving at a preferred option. Costs, benefits, and disbenefits of the base options were evaluated and discussed in Section 5. Only overriding considerations are presented in subsequent paragraphs in order to eliminate programs and narrow the field down to a preferred option. Table 7-1 lists the options that have been evaluated. In addition to the evaluation; input from the following sources were considered:

- The Air Quality Review Committee and its Technical Subcommittee
- The Vehicle I/M Advisory Committee
- The Legislative Liaison Committee
- The Inter-Agency Vehicle I/M Technical Committee
- A Public Opinion Poll conducted by the Highway Safety Research Institute in Ann Arbor, Michigan
- The United States EPA
- Comments at the Michigan State Implementation Plan public hearings

7.1 SAFETY AND NOISE INSPECTIONS

Safety and noise inspection costs and benefits were presented in Section 5. The following overriding considerations have eliminated this combined air quality/safety/noise testing approach:

- Mandatory safety and/or noise inspection programs are not currently operating in Michigan (Volume II, Section 5.3 p. 5-21). While benefits may be realized from implementing these programs, neither will improve air quality, and both increase total program costs and costs to the consumer (Volume II, Table 5-20, p. 5-30). The Michigan Legislature must decide if it is wise to go far beyond the intent of the Clean Air Act to include other programs within a program designed specifically to improve air quality.

Table 7-1. ADMINISTRATIVE APPROACH VERSUS METHOD OF TEST

Administrative Approach	Method of Test Idle	 Loaded	 Engine Parameter/ Device Inspection
State-operated			
Without safety and noise	Option 1*	Option 9*	Option 17*
With safety and noise	Option 2*	Option 10	Option 18
Contractor-operated			
Without safety and noise	Option 3*	Option 11	Option 19
With safety and noise	Option 4	Option 12	Option 20
Private garage			
Without safety and noise	Option 5*	Option 13	Option 21
With safety and noise	Option 6	Option 14	Option 22
Statistical sampling			
Without safety and noise	Option 7*	Option 15	Option 23
With safety and noise	Option 8	Option 16	Option 24

*Base options

- States with safety programs currently operating question the effectiveness of safety inspections in reducing vehicle defect related accidents
- I/M programs that include safety and noise cost 30% more than programs testing emissions alone (Volume II, Table 6-1, p. 6-3)
- Experience from other safety and emissions testing programs indicates that a high percentage of the tested vehicles fail the combined test. Costs for retesting failed vehicles will increase accordingly (Volume I, Section 2, p. 5)
- Average repair costs for vehicles needing repair will be higher
- Any I/M test mode is capable of identifying most of the vehicles that would fail a noise inspection, since most faulty mufflers or illegally modified exhaust systems are audible. In some cases faulty mufflers must be corrected prior to an emissions test, since exhaust leaks make it impossible to obtain accurate test results
- Program implementation will take longer due to increased program complexity
- It may be difficult to obtain legal authority for the combined program since the required legislation is much more complex and controversial than I/M legislation alone

7.2 STATISTICAL SAMPLE

The statistical sample administrative approach requires the inspection of a small portion of the vehicle population. The costs, benefits and disbenefits of this option were described in Section 5. The following overriding considerations have eliminated this testing approach:

- It is not possible for the State of Michigan to demonstrate that the emission reduction from I/M required by EPA policy can be achieved by this program. This type of program may be able to demonstrate where overall emissions are, and what further reductions are possible through a vehicle I/M program (Volume II, Section 1, p. 1-2)
- Other control strategies either from stationary sources or from other transportation control strategies will be required to offset the shortfall in emission reductions obtained through this program

- This approach is not acceptable to the federal EPA, since it does not fulfill the Clean Air Act Amendment requirement for I/M to be "mandatory and periodic." (Volume I, Appendix A)

7.3 STATE OPERATED SYSTEM

The State operated administrative approach's costs, benefits, and disbenefits were discussed in Section 5. The following overriding considerations have eliminated this administrative approach:

- The initial costs to the State to implement the program are high (Volume II, Table 6-1, p. 6-3)
- There is uncertainty in obtaining required funds to implement the program
- Governmental employment will be greatly expanded as compared to other private sector administrative approaches (Volume II, Table 5-4, p. 5-10)
- There will be a loss of property tax revenues collected by local governments because taxes are not levied on State-owned facilities
- Flexibility to terminate the program is lacking
- Implementation time is likely to be greater due to the involvement of many state agencies, and because legal, financial, administrative, and hiring requirements are more complex in the public sector than in the private sector

7.4 PRIVATE GARAGE SYSTEM

The costs, benefits and disbenefits of this option were discussed in Section 5. The following overriding considerations have eliminated this administrative approach:

- There is reluctance by the private sector and consumers to have private garages perform both the inspection and repair due to a potential and/or perceived conflict of interest
- A high turnover rate (10%/yr) of garage ownership is experienced in Michigan. This makes it difficult to quantify program costs since the level of participation by garages is unknown

- Quality assurance costs are higher because instruments at many stations must be calibrated and checked for accuracy regularly. It is also necessary to check regularly for proper testing procedures and valid repairs (Volume II, Table 5-37, p. 5-52)
- More resources must be devoted to private garage licensing, quality control and complaint investigation than for the other administrative approaches (Volume II, Section 5.5.6, p. 5-58)
- So far, all of the states with private garage run I/M programs are states that had pre-existing safety inspection facilities. I/M was added onto their safety program. This substantially reduces planning time and capital required to implement the program. This is not the case in Michigan (Volume I, Section 2.2, p. 7)
- Most vehicles would have to be scheduled, by appointment, for inspection at a private garage, since most garages would be unable to achieve a high output rate. This increases the average workload at private garages and may increase average waiting times. In other inspection approaches, only the failed vehicles (20-30%) must schedule garage appointments. The overall effects of the added workload and its effect on program costs and consumer costs are not possible to predict at this time

7.5 LOADED-MODE TEST

The loaded-mode test costs, benefits, and disbenefits were discussed in Section 5. Based on information to date, the loaded-mode test has been eliminated. If additional monitoring data indicates an NO_x problem, or if other pertinent technical information suggests that a loaded test is needed, this decision will be reconsidered. The following statements indicate the reasons for eliminating a loaded-mode test:

- The loaded-mode test provides substantial diagnostic information. The benefit of the additional information is dependent on the mechanic's ability to use the diagnostics. So far there is no indication that mechanics effectively use this diagnostic information when repairing vehicles (Volume II, Section 5.7.6, p. 5-76)

- A loaded-mode test does not increase the amount of emission reductions obtained by the program (Volume I, Appendix A)
- The repair industry may find it expensive and impractical to buy a dynamometer to duplicate loaded-mode test results for repair purposes. If a repair garage cannot duplicate the test to see if repairs are correct there is a possibility of additional retests and additional consumer dissatisfaction
- A loaded-mode test costs 18% more than an idle-mode test (Volume II, Table 6-1, p. 6-3)
- If heavy duty vehicles are included in a loaded-mode test I/M program, special double axle dynamometers will be necessary. This substantially increases program costs (Volume II, Section 2.1, p. 2-1)

7.6 ENGINE PARAMETER/DEVICE INSPECTION

The parameter inspections identified in this study are time intensive and costly, but other device inspections may prove to be more cost effective. Although this is not a preferred option; this option has not been eliminated completely.

The following issues must be considered:

- The parameter inspection defined in this report is approximately four times as expensive as an idle test (Volume II, Table 6-1, p. 6-3)
- Very little information is available pertaining to the test time (and subsequently output rate at inspection stations) involved in parameter testing (Volume II, Section 3.2.3, p. 3-6)
- I/M facilities for another test mode may be designed to include flexibility to change to a parameter/device inspection test mode. If a cost effective parameter test is developed this option may be chosen
- EPA has not established a method for calculating emission reduction credits for this test type. Currently, the burden of proof of emission reductions from this type of program is on the individual states (Volume I, Appendix A)

7.7 SELECTION OF CANDIDATE OPTIONS

With the elimination of safety and noise inspections as discussed in Section 7.1, Options 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, and 23 remain as shown in Table 7-1. The reasons to eliminate these options are still valid regardless of the test mode.

Options 7, 15, and 23 are eliminated by removing the statistical sampling as an administrative approach. Again, the overriding considerations are independent of the test mode.

Options 3, 5, 11, 13, 19, and 21 remain candidates after elimination of the State-operated administrative approach. Again, the overriding considerations are not a function of the test mode considered.

Options 3, 11, and 19 remain after elimination of the private sector as a vaiable administrative approach. Although the overriding considerations are applicable to all test modes, the loaded-mode test is not amenable to the private sector due primarily to the cost of the test equipment. After the loaded-mode test is eliminated, Options 3 and 19 remain under the contractor administrative approach.

As stated in Section 7.6, the engine parameter inspection is not an immediate candidate. Option 3, the contractor-operated idle test, is the selected viable candidate.

7.8 CONCLUSIONS

The contractor operated-idle mode test (Option 3) is the preferred option. Although the state run program option has been eliminated, it will be necessary to continue a dual costing of state and contractor run programs for comparative purposes. This will provide the state with the ability to evaluate contractor bids against the cost for the state to run the program. If the state is unable ot obtain reasonable bids, it would then be possible for the state to pick up the program.

While parameter testing is not a preferred approach, this option will remain under consideration. Other states have undertaken vehicle testing programs to learn more about parameter testing. It is possible that the results of these programs will define a cost effective parameter test suitable for application in Michigan.

The Michigan Department of Transportation may also wish to consider combinations of options. For example, a centralized idle test with reinspection and repair in private garages may be a viable approach. Phase II will provide the opportunity to look into this and other combinations. In addition, further analysis is necessary to provide answers to the following questions:

- Should heavy duty gas and diesel vehicles be included in the program?
- What emission cut point should be used to obtain a given failure rate?
- How many lanes should there be at each facility? How should facility locations be chosen?
- Should a maximum repair cost be set, and if "yes", how should it be set?
- Should centralized and decentralized facilities be used in a combination of urban and rural areas?
- How can mobile inspection stations be used in rural areas?
- Can simple energy saving checks be made at an I/M station?
- Can energy benefits of I/M be more accurately quantified? If "yes", can I/M be used as a cost effective energy saving strategy?

These and other questions will be answered in Phase II.

Section 8

GENERAL DEFINITIONS

These definitions are commonly used in inspection and emissions testing procedures and I/M programs.

accuracy: The degree by which an instrument is able to determine the true concentration of a pollutant in the exhaust gas sampled.

air contaminants: Any fumes, smoke, particulate matter, vapor gas, or any combination, but excluding water vapor or steam condensate.

air-fuel ratio: The expression of the proportional mixture by weight of air to gasoline created by the carburetor. Usually expressed as a numerical relationship such as 14:1, 13:1, etc.

ambient air: The surrounding or outside air.

analyzer: An instrument which samples and determines the concentration of a particular gas of interest.

calibration gases: A blend of hydrocarbon and carbon monoxide gases at known concentrations using nitrogen as the inert carrier gas.

carbon monoxide: A nonirritating, colorless, odorless, but nonetheless toxic gas which has the molecular form of CO.

catalytic converter: Device to reduce automobile emissions by converting CO and HC emissions to harmless carbon dioxide and water.

certificate of compliance: A document which is issued upon completion of inspection which records the results and serves as proof for vehicle owner.

certified mechanic: An individual certified by the State or I/M program office, to install, repair and adjust motor vehicle engine emissions-related components and pollution control devices so that the motor vehicle meets emissions standards.

certified station: A private facility certified by the State or I/M program office, to install, repair and adjust motor vehicle engine emissions-related components and pollution control devices so that the vehicle meets applicable emissions standards.

chassis dynamometer: A test instrument equipped with two parallel rollers that support the rear wheels of a motor vehicle. When positioned on the dynamometer the vehicle may be "driven" to simulate the road operation. A power absorption unit is connected to the rollers to simulate the loading from the various sources of fluid and mechanical friction present during road operation. Weights can also be coupled to the rollers to simulate the inertial effects of vehicle mass during acceleration and deceleration.

crankcase emissions: The products of combustion emitted into the ambient air from the engine crankcase ventilation system.

cut point: A threshold value of measured tail pipe pollutant emission concentration above which a vehicle will fail an emissions inspection.

degradation: An increase in emissions due to normal wear of engine system.

deterioration: A synonym for degradation indicating an increase in emission levels due to wear.

drift: The amount of analyzer meter reading change over a period of time. Zero drift refers to change of zero reading when a zero gas is flowing through the analyzer. Span drift refers to a change in reading of an analyzer meter when a calibration gas of known concentration is flowing through the analyzer.

emission inspection program: An inspection and maintenance program in which each vehicle is subjected to a test of its emissions under specified conditions. The emission levels are compared with a standard established for the vehicle class. If the emissions are higher than the standard, the vehicle fails and must be adjusted or repaired to bring its emissions to within the standards.

engine family: The basic classification unit of a manufacturer's product line used for the purpose of test-fleet selection.

engine-system combination: Both an engine family-exhaust emission control system and a fuel evaporative emission control system.

exhaust emissions: The gases emitted into the ambient air from any opening downstream of the exhaust ports of an engine.

exhaust gas analyzers: Instruments that can determine the amounts of one or more gas(es) in the exhaust of a motor vehicle.

failure rate: The percentage of vehicles tested that fails inspection.

fleet operator: The owner of a fleet of a designated number of vehicles.

fleet owner authorized stations: Stations operated by a fleet owner under certified authority to perform vehicle emissions inspection and limited to his fleet only.

fuel system: Combination of fuel tank, feeder lines, fuel pump, and evaporative emissions control system.

gross vehicle weight: The manufacturer's gross weight rating for the individual vehicle.

hang-up: HC which clings to the surface of the sampling and analyzer system in contract with the gas sample stream which causes an erroneous indication of HC in the measured value.

heavy-duty vehicle: Any motor vehicle designed for highway use having a gross vehicle weight of more than 8,500 pounds.

hydrocarbons: An organic compound whose molecular composition consists of atoms of hydrogen and carbon only. Gasoline is composed of various hydrocarbons.

idle test: An emission inspection program which measures the exhaust emission from a motor vehicle operating at idle. (No motion of the rear wheels.) A vehicle with an automatic transmission may be in "drive" with brakes applied or in neutral gear.

independent contractor: Any person, business firm, partnership, or corporation with whom the State may enter into an agreement providing for the construction, equipment, maintenance, personnel, management and/or operation of official inspection stations.

inspection and maintenance program: A program to reduce emissions from in-use vehicles through identifying vehicles that need emissions control-related maintenance and requiring that maintenance be performed. Abbreviated as I/M program.

inspection station: A facility used for inspecting or testing motor vehicles and pollution control devices for compliance with applicable regulations.

inspector: An individual who inspects motor vehicles and pollution control devices for compliance with applicable regulations.

light-duty vehicle: A motor vehicle designed for highway use and less than 6,001 pounds gross vehicle weight. Further distinctions are sometimes made between light-duty automobiles and light-duty trucks such as pickup trucks.

loaded mode test: An emission inspection program which measures the exhaust emissions from a motor vehicle operating under simulated road load on a chassis dynamometer.

medium-duty vehicle: A motor vehicle designed for highway use with a gross vehicle weight between 6,000 and 8,500 pounds.

model-year of vehicle: The production period of new vehicle designated by the calendar year in which such period ends.

motor vehicle: Any self-propelled vehicle which is designed primarily for travel on public right-of-way streets and is used to transport persons and/or property.

output rate: The number of vehicles that can be processed at a test lane per unit time. The longest work station test time defines the output rate.

oxides of nitrogen: Any molecule containing nitrogen and oxygen only. For air pollution purposes, only nitric oxide (NO) and nitrogen dioxide (NO_2).

pollution control device: Equipment designed for installation on a motor vehicle to reduce pollutants emitted from the vehicle, or an engine modification resulting in pollutant reduction.

positive crankcase ventilation: A system designed to return blowby gases from the crankcase of the engine to the intake manifold to burn them in the engine. Blowby gas is unburned fuel/air mixture that leaks past the piston rings into the crankcase during the compression and ignition cycles of the engine. Without positive crankcase ventilation, these gases which are rich in hydrocarbons escape to the atmosphere.

prescribed inspection procedure: Approved procedure for identifying vehicles that need emissions control-related maintenance.

quality: The results of engineering and manufacturing that determine the degree to which the product meets design specifications.

registered owner: An individual, firm, corporation, or association whose name appears in the files of the Department of State as the owner of the vehicle.

repeatability: The instrument's capability to provide the same value for successive measures of the same sample.

response time: The period of time required by an instrument to provide a readout after a step-change in gas concentration level initiated at the tail pipe sample probe.

smoke: Small gasborne and airborne particles, exclusive of water vapor, resulting from insufficient combustion and in sufficient number to be visible.

stringency factor: A design or theoretical failure rate.

tampering: The alteration, modification, or disconnection of emission control devices.

vehicle dealer: An individual, firm, corporation or association who is licensed to sell motor vehicles.

vehicle emissions standard: A specific emission limit allowed for a class of vehicles. The standard is normally expressed in terms of maximum allowable concentrations of pollutants (e.g., parts per million). However, a standard could also be expressed in terms of mass emissions per unit of time or distance traveled (e.g., grams per mile).

Appendix A

VEHICLE POPULATION DATA BY AREA OF COVERAGE

LIGHT-DUTY VEHICLE POPULATION
YEAR - 1977

	MOTOR VEHICLE POPULATION											
	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
COUNTY	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%
Alcona	4.73	0.1										
Alger	4.08	0.1										
Allegan	34.71	0.7	34.71	0.8								
Alpena	15.54	0.3										
Antrim	7.89	0.2										
Arenac	6.01	0.1										
Baraga	3.64	0.1										
Barry	19.21	0.4	19.21	0.5								
Bay	59.53	1.3	59.53	1.4								
Benzie	5.35	0.1										
Berrien	87.38	1.9	87.38	2.1								
Branch	18.94	0.4	18.94	0.4								
Calhoun	72.33	1.6	72.33	1.7								
Cass	22.84	0.5	22.84	0.5								
Charlevoix	9.79	0.2										
Cheboygan	9.75	0.2										
Chippewa	14.53	0.3										
Clare	10.12	0.2										
Clinton	24.88	0.5	24.88	0.6			24.88	12.8				
Crawford	4.41	0.1										
Delta	18.01	0.4										
Dickinson	12.92	0.3										
Eaton	37.39	0.8	37.39	0.9			37.39	19.3				
Emmet	11.37	0.2										
Genesee	226.91	4.9	226.91	5.4					226.91	100		
Gladwin	7.98	0.2										
Gogebic	8.76	0.2										
Gd. Traverse	28.14	0.6										
Gratiot	18.50	0.4										
Hillsdale	19.17	0.4	19.17	0.5								
Houghton	14.63	0.3										
Huron	17.90	0.4	17.90	0.4								
Ingham	131.79	2.8	131.79	3.1			131.79	67.9				
Ionia	21.18	0.5	21.18	0.5								
Iosco	13.62	0.3										
Iron	6.81	0.1										
Isabella	18.82	0.4										
Jackson	72.64	1.6	72.64	1.7								
Kalamazoo	105.31	2.3	105.31	2.5								
Kalkaska	4.72	0.1										
Kent	229.66	4.9	229.66	5.4	229.66	75.7						
Keweenaw	1.08	0.0										
Lake	3.30	0.1										

(continued)

LIGHT-DUTY VEHICLE POPULATION (Continued)
YEAR - 1977

	MOTOR VEHICLE POPULATION											
	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
COUNTY	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%
Lapeer	27.77	0.6	27.77	0.7								
Leelanau	6.48	0.1										
Lenawee	42.63	0.9	42.63	1.0								
Livingston	40.16	0.9	40.16	1.0								
Luce	2.85	0.1										
Mackinac	4.42	0.1										
Macomb	384.50	8.3	384.50	9.1							384.50	16.4
Manistee	10.96	0.2										
Marquette	31.39	0.7	31.39	0.7								
Mason	12.17	0.3										
Mecosta	12.16	0.3										
Menominee	12.30	0.3										
Midland	36.48	0.8	36.48	0.9								
Missaukee	4.12	0.1										
Monroe	62.25	1.3	62.25	1.5							62.25	2.7
Montcalm	20.82	0.4	20.82	0.5								
Montmorency	3.63	0.1										
Muskegon	77.95	1.7	77.95	1.8								
Newaygo	14.75	0.3										
Oakland	560.98	12.1	560.98	13.3							560.98	24.0
Oceana	9.15	0.2										
Ogemaw	7.39	0.2										
Ontonagon	4.85	0.1										
Osceola	8.02	0.2										
Oscoda	3.12	0.1										
Otsego	6.87	0.1										
Ottawa	73.67	1.6	73.67	1.7	73.67	24.3						
Presque Isle	6.68	0.1										
Roscommon	8.24	0.2										
Saginaw	114.18	2.5	114.18	2.7								
St. Clair	64.78	1.4	64.78	1.5								
St. Joseph	26.55	0.6	26.55	0.6								
Sanilac	18.21	0.4	18.21	0.4								
Schoolcraft	4.28	0.1										
Shiawassee	32.38	0.7	32.38	0.8								
Tuscola	24.47	0.5	24.47	0.6								
Van Buren	29.70	0.6	29.70	0.7								
Washtenaw	125.26	2.7	125.26	3.0							125.26	5.4
Wayne	1206.50	26.0	1206.50	28.6							1206.50	51.6
Wexford	11.69	0.3										
Foreign	15.62	0.3										
Total	4647.45	100	4220.80	100	303.33	100	194.06	100	226.91	100	2339.49	100

PROJECTED LIGHT-DUTY VEHICLES POPULATION
YEAR - 1983

	MOTOR VEHICLE POPULATION											
	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
COUNTY	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%
Alcona	5.58	0.1										
Alger	4.81	0.1										
Allegan	40.85	0.7	40.85	0.8								
Alpena	18.29	0.3										
Antrim	9.28	0.2										
Arenac	7.07	0.1										
Baraga	4.28	0.1										
Barry	22.61	0.4	22.61	0.5								
Bay	70.07	1.3	70.07	1.4								
Benzie	6.30	0.1										
Berrien	102.85	1.9	102.85	2.1								
Branch	22.29	0.4	22.29	0.4								
Calhoun	85.13	1.6	85.13	1.7								
Cass	26.88	0.5	26.88	0.4								
Charlevoix	11.52	0.2										
Cheboygan	11.47	0.2										
Chippewa	17.10	0.3										
Clare	11.91	0.2										
Clinton	29.28	0.5	29.28	0.6			29.28	12.8				
Crawford	5.19	0.1										
Delta	21.20	0.4										
Dickinson	15.21	0.3										
Eaton	44.00	0.8	44.00	0.9			44.00	19.3				
Emmet	13.38	0.2										
Genesee	267.08	4.9	267.08	5.4					267.08	100		
Gladwin	9.39	0.2										
Gogebic	10.31	0.2										
Gd. Traverse	33.12	0.6										
Gratiot	21.77	0.4	21.77	0.4								
Hillsdale	22.56	0.4	22.36	0.5								
Houghton	17.22	0.3										
Huron	21.07	0.4	21.07	0.4								
Ingham	155.12	2.8	155.12	3.1			155.12	67.9				
Ionia	24.93	0.5	24.93	0.5								
Iosco	16.03	0.3										
Iron	8.01	0.1										
Isabella	22.15	0.4										
Jackson	85.50	1.6	85.50	1.7								
Kalamazoo	123.95	2.3	123.95	2.5								
Kalkaska	5.56	0.1										
Kent	270.31	4.9	270.31	5.4	270.31	75.7						
Keweenaw	1.27	0.0										
Lake	3.38	0.1										

(continued)

PROJECTED LIGHT-DUTY VEHICLES POPULATION (Continued)
YEAR - 1983

COUNTY	MOTOR VEHICLE POPULATION											
	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%
Lapeer	32.68	0.6	32.68	0.7								
Leelanau	7.63	0.1										
Lenawee	50.17	0.9	50.17	1.0								
Livingston	47.26	0.9	47.26	1.0								
Luce	3.35	0.1										
Mackinac	5.20	0.1										
Macomb	452.55	8.3	452.55	9.1							452.55	16.4
Manistee	12.90	0.2										
Marquette	36.95	0.7	36.95	0.7								
Mason	14.33	0.3										
Mecosta	14.31	0.3										
Menominee	14.48	0.3										
Midland	42.93	0.8	42.93	0.9								
Missaukee	4.84	0.1										
Monroe	73.27	1.3	73.27	1.5							73.27	2.7
Montcalm	24.51	0.4	24.51	0.5								
Montmorency	4.27	0.1										
Muskegon	91.75	1.7	91.75	1.8								
Newaygo	17.36	0.3										
Oakland	660.27	12.1	660.27	13.3							660.27	24.0
Oceana	10.77	0.2										
Ogemaw	8.69	0.2										
Ontonagon	5.71	0.1										
Osceola	9.44	0.2										
Oscoda	3.68	0.1										
Otsego	8.09	0.1										
Ottawa	86.71	1.6	86.71	1.7	86.71	24.3						
Preseque Isle	7.86	0.1										
Roscommon	9.70	0.2										
Saginaw	134.39	2.5	134.39	2.7								
St. Clair	76.25	1.4	76.25	1.5								
St. Joseph	31.25	0.6	31.25	0.6								
Sanilac	21.43	0.4	21.43	0.4								
Schoolcraft	5.03	0.1										
Shiawassee	38.11	0.7	38.11	0.8								
Tuscola	28.80	0.5	28.80	0.5								
Van Buren	34.96	0.6	34.96	0.7								
Washtenaw	147.43	2.7	147.43	3.0							147.43	5.4
Wayne	1420.05	26.0	1420.05	28.6							1420.05	51.6
Wexford	13.76	0.3										
Foreign	18.39	0.3										
Total	5470.04	100	4967.97	100	357.02	100	228.40	100	267.08	100	2753.37	100

PROJECTED LIGHT-DUTY VEHICLES POPULATION
YEAR - 1987

	MOTOR VEHICLE POPULATION											
	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
COUNTY	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%
Alcona	6.39	0.1										
Alger	5.51	0.1										
Allegan	46.78	0.7	46.78	0.8								
Alpena	20.95	0.3										
Antrim	10.63	0.2										
Arenac	8.09	0.1										
Baraga	4.90	0.1										
Barry	25.89	0.4	25.89	0.5								
Bay	80.25	1.3	80.25	1.4								
Benzie	7.22	0.1										
Berrien	117.79	1.9	117.79	2.1								
Branch	25.52	0.4	25.52	0.4								
Calhoun	97.50	1.6	97.50	1.7								
Cass	30.78	0.5	30.78	0.5								
Charlevoix	13.19	0.2										
Cheboygan	13.14	0.2										
Chippewa	19.58	0.3										
Clare	13.64	0.2										
Clinton	33.54	0.5	33.54	0.6			33.54	12.8				
Crawford	5.94	0.1										
Delta	24.28	0.4										
Dickinson	17.42	0.3										
Eaton	50.40	0.8	50.40	0.9			50.40	19.3				
Emmet	15.32	0.2										
Genesee	305.88	4.9	305.88	5.4					305.88	100		
Gladwin	10.76	0.2										
Gogebic	11.80	0.2										
Gd. Traverse	37.93	0.6										
Gratiot	24.93	0.4	24.93	0.4								
Hillsdale	25.83	0.4	25.83	0.5								
Houghton	19.72	0.3										
Huron	24.13	0.4	24.17	0.4								
Ingham	177.66	2.8	177.66	3.1			177.66	67.9				
Ionia	28.55	0.5	28.55	0.5								
Iosco	18.35	0.3										
Iron	9.18	0.1										
Isabella	25.37	0.4										
Jackson	97.92	1.6	97.92	1.7								
Kalamazoo	141.96	2.3	141.96	2.5								
Kalkaska	6.36	0.1										
Kent	309.58	4.9	309.58	5.4	309.58	75.7						
Keweenaw	1.46	0.0										
Lake	4.45	0.1										

(continued)

PROJECTED LIGHT-DUTY VEHICLES POPULATION (Continued)
YEAR - 1987

	MOTOR VEHICLE POPULATION											
	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
COUNTY	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%
Lapeer	37.43	0.6	37.43	0.7								
Leelanau	8.74	0.1										
Lenawee	57.46	0.9	57.46	1.0								
Livingston	54.13	0.9	54.13	1.0								
Luce	3.84	0.1										
Mackinac	5.95	0.1										
Macomb	518.30	8.3	518.30	9.1							518.30	16.4
Manistee	14.77	0.2										
Marquette	42.31	0.7	42.31	0.7								
Mason	16.41	0.3										
Mecosta	16.39	0.3										
Menominee	16.58	0.3										
Midland	49.17	0.8	49.17	0.9								
Missaukee	5.55	0.1										
Monroe	83.92	1.3	83.92	1.5							83.92	2.7
Montcalm	28.07	0.4	28.07	0.5								
Montmorency	4.89	0.1										
Muskegon	105.08	1.7	105.08	1.8								
Newaygo	19.89	0.3										
Oakland	756.20	12.1	756.20	13.3							756.20	24.0
Oceana	12.34	0.2										
Ogemaw	9.96	0.2										
Ontonagon	6.54	0.1										
Osceola	10.81	0.2										
Oscoda	4.21	0.1										
Otsego	9.26	0.1										
Ottawa	99.30	1.6	99.30	1.7	99.30	24.3						
Presque Isle	9.00	0.1										
Roscommon	11.11	0.2										
Saginaw	153.91	2.5	153.91	2.7								
St. Clair	87.33	1.4	87.33	1.5								
St. Joseph	35.79	0.6	35.79	0.6								
Sanilac	24.54	0.4	24.54	0.4								
Schoolcraft	5.76	0.1										
Shiawassee	43.64	0.7	43.64	0.8								
Tuscola	32.99	0.5	32.99	0.6								
Van Buren	40.04	0.6	40.04	0.7								
Washtenaw	168.85	2.7	168.85	3.0							168.85	5.4
Wayne	1626.37	26.0	1626.37	28.6							1626.37	51.6
Wexford	15.76	0.3										
Foreign	21.06	0.3										
Total	6264.76	100	5689.76	100	408.88	100	261.60	100	305.88	100	3153.64	100

LIGHT-DUTY TRUCK POPULATION
YEAR - 1977

COUNTY	MOTOR VEHICLE POPULATION											
	Statewide	%	Nonattainment Counties	%	Grand Rapids	%	Lansing	%	Flint	%	Detroit	%
Alcona	1,501	.20										
Alger	1,518	.20										
Allegan	10,360	1.36	10,360	1.61								
Alpena	4,607	.60										
Antrim	2,177	.29										
Arenac	1,976	.26										
Baraga	1,396	.18										
Barry	6,085	.80	6,085	.95								
Bay	11,097	1.46	11,097	1.73								
Benzie	1,558	.20										
Berrien	19,099	2.51	19,099	2.97								
Branch	5,781	.76	5,781	.90								
Calhoun	14,385	1.89	14,385	2.24								
Cass	7,061	.93	7,061	1.10								
Charlevoix	2,764	.36										
Cheboygan	2,971	.39										
Chippewa	4,240	.56										
Clare	3,293	.43										
Clinton	7,488	.98	7,488	1.17			7,488	20.79				
Crawford	1,296	.17										
Delta	5,348	.70										
Dickinson	3,322	.44										
Eaton	9,160	1.20	9,160	1.45			9,160	25.44				
Emmet	3,065	.40										
Genesee	40,239	5.28	40,239	6.26					40,239	100		
Gladwin	2,757	.36										
Gogebic	2,756	.36										
Gd. Traverse	6,633	.87										
Gratiot	5,467	.72	5,467	.85								
Hillsdale	5,978	.78	5,978	.93								
Houghton	3,774	.50										
Huron	5,192	.68	5,192	.81								
Ingham	19,361	2.54	19,361	3.01			19,361	53.77				
Ionia	6,142	.81	6,142	.96								
Iosco	3,462	.45										
Iron	2,438	.32										
Isabella	5,003	.66										
Jackson	15,300	2.01	15,300	2.38								
Kalamazoo	18,295	2.40	18,295	2.85								
Kalkaska	1,840	.24										
Kent	32,495	4.27	32,495	5.06	32,495	70.20						
Keweenaw	301	.04										
Lake	1,073	.14										

(continued)

LIGHT-DUTY TRUCK POPULATION (Continued)
YEAR - 1977

COUNTY	MOTOR VEHICLE POPULATION Statewide	%	Nonattainment Counties	%	Grand Rapids	%	Lansing	%	Flint	%	Detroit	%
Lapeer	8,176	1.1	8,176	1.27								
Leelanau	1,809	.24										
Lenawee	11,012	1.45	11,012	1.71								
Livingston	9,721	1.28	9,721	1.51								
Luce	1,114	.15										
Mackinac	1,517	.20										
Macomb	41,654	5.47	41,654	6.48							41,654	16.48
Manistee	2,790	.37										
Marquette	8,846	1.16	8,846	1.38								
Mason	3,388	.44										
Mecosta	3,704	.49										
Menominee	3,412	.45										
Midland	6,977	.92	6,977	1.09								
Missaukee	1,674	.22										
Monroe	13,455	1.77	13,455	2.09							13,455	5.32
Montcalm	6,564	.86	6,564	1.02								
Montmorency	1,341	.18										
Muskegon	14,794	1.94	14,794	2.30								
Newaygo	4,752	.62										
Oakland	67,077	8.80	67,077	10.44							67,077	26.5
Oceana	3,193	.42										
Ogemaw	2,491	.33										
Ontonagon	1,719	.23										
Osceola	2,880	.38										
Oscoda	1,145	.15										
Otsego	2,116	.28										
Ottawa	13,793	1.81	13,793	2.14	13,793	29.80						
Presequе Isle	2,320	.30										
Roscommon	2,414	.32										
Saginaw	19,051	2.50	19,051	2.97								
St. Clair	12,870	1.69	12,870	2.00								
St. Joseph	7,529	.99	7,529	1.17								
Sanilac	5,681	.75	5,681	.88								
Schoolcraft	1,403	.18										
Shiawassee	8,967	1.18	8,967	1.40								
Tuscola	7,772	1.02	7,772	1.21								
Van Buren	8,965	1.18	8,965	1.40								
Washtenaw	18,421	2.42	18,421	2.87							18,421	7.29
Wayne	112,214	14.73	112,214	17.46							112,214	44.38
Wexford	3,101	.41										
Foreign	—	—										
Total	761,811	100	642,524	100	46,288	100	36,009	100	40,239	100	252,921	100

MEDIUM-DUTY TRUCK POPULATION
YEAR - 1977

	MOTOR VEHICLE POPULATION											
COUNTY	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
		%		%		%		%		%		%
Alcona	29	.12										
Alger	27	.11										
Allegan	344	1.40	344	1.6								
Alpena	90	.37										
Antrim	63	.26										
Arenac	104	.42										
Baraga	17	.07										
Barry	172	.70	172	.8								
Bay	391	1.59	391	1.8								
Benzie	49	.20										
Berrien	734	2.98	734	3.4								
Branch	200	.81	200	9.3								
Calhoun	422	1.71	422	1.96								
Cass	247	1.00	247	1.14								
Charlevoix	48	.19										
Cheboygan	79	.32										
Chippewa	109	.44										
Clare	67	.27										
Clinton	228	.93	228	1.06			228	14.46				
Crawford	17	.07										
Delta	94	.38										
Dickinson	91	.37										
Eaton	286	1.16	286	1.33			286	18.14				
Emmet	99	.40										
Genesee	729	2.96	729	3.38					729	100		
Gladwin	52	.21										
Gogebic	45	.18										
Gd. Traverse	201	.82										
Gratiot	230	.93	230	1.07								
Hillsdale	259	1.05	259	1.20								
Houghton	71	.29										
Huron	547	2.22	547	2.53								
Ingham	1,063	4.32	1,063	4.93			1,063	67.41				
Ionia	205	.83	205	.95								
Iosco	66	.27										
Iron	35	.14										
Isabella	176	.71										
Jackson	415	1.69	415	1.92								
Kalamazoo	447	1.82	447	2.07								
Kalkaska	60	.24										
Kent	1,139	4.63	1,139	5.28	1,139	72.69						
Keweenaw	3	.01										
Lake	25	.10										

(continued)

MEDIUM-DUTY TRUCK POPULATION (Continued
YEAR - 1977

COUNTY	MOTOR VEHICLE POPULATION Statewide	%	Nonattainment Counties	%	Grand Rapids	%	Lansing	%	Flint	%	Detroit	%
Lapeer	228	.93	228	1.06								
Leelanau	91	.37										
Lenawee	614	2.49	614	2.85								
Livingston	234	.95	234	1.09								
Luce	18	.07										
Mackinac	35	.14										
Macomb	1,173	4.76	1,173	5.44							1,173	14.25
Manistee	83	.34										
Marquette	167	.68	167	.77								
Mason	92	.37										
Mecosta	101	.41										
Menominee	137	.56										
Midland	170	.69	170	.79								
Missaukee	60	.24										
Monroe	696	2.83	696	3.23							696	8.45
Montcalm	170	.69	170	.79								
Montmorency	23	.09										
Muskegon	399	1.62	399	1.85								
Newaygo	128	.52										
Oakland	1,719	6.98	1,719	7.97							1,719	20.88
Oceana	124	.50										
Ogemaw	57	.23										
Ontonagon	20	.08										
Osceola	73	.30										
Oscoda	25	.10										
Otsego	51	.21										
Ottawa	428	1.74	428	1.98	428	27.31						
Presque Isle	99	.40										
Roscommon	27	.11										
Saginaw	794	3.23	794	3.68								
St. Clair	361	1.47	361	1.67								
St. Joseph	217	.88	217	1.00								
Sanilac	283	1.15	283	1.31								
Schoolcraft	17	.07										
Shiawassee	348	1.41	348	1.61								
Tuscola	499	2.03	499	2.31								
Van Buren	377	1.51	377	1.75								
Washtenaw	553	2.25	553	2.56							553	6.72
Wayne	4,092	16.62	4,092	18.96							4,092	49.70
Wexford	73	.30										
Foreign	--	--										
Total	24,620	100	21,580	100	1,567	100	1,577	100	729	100	8,233	100

HEAVY-DUTY TRUCK POPULATION
YEAR - 1977

	MOTOR VEHICLE POPULATION											
COUNTY	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
Alcona	62	.07										
Alger	63	.07										
Allegan	1,025	1.21	1,025	1.35								
Alpena	339	.40										
Antrim	149	.18										
Arenac	187	.22										
Baraga	69	.08										
Barry	272	.32	272	.36								
Bay	1,582	1.86	1,582	2.08								
Benzie	87	.10										
Berrien	1,661	1.96	1,661	2.19								
Branch	613	.72	613	.8								
Calhoun	1,109	1.31	1,109	1.45								
Cass	528	.62	528	.70								
Charlevoix	136	.16										
Cheboygan	208	.25										
Chippewa	317	.37										
Clare	184	.22										
Clinton	634	.75	634	.84			634	17.74				
Crawford	66	.08										
Delta	611	.72										
Dickinson	456	.54										
Eaton	638	.75	638	.84			638	17.86				
Emmet	267	.31										
Genesee	3,415	4.02	3,415	4.50					3,415	100		
Gladwin	120	.14										
Gogebic	146	.17										
Gd. Traverse	636	.75										
Gratiot	626	.74	626	.82								
Hillsdale	666	.78	666	.88								
Houghton	262	.31										
Huron	917	1.08	917	1.2								
Ingham	2,301	2.71	2,301	3.03			2,301	64.40				
Ionia	455	.54	455	.60								
Iosco	228	.27										
Iron	119	.14										
Isabella	504	.59										
Jackson	1,310	1.54	1,310	1.73								
Kalamazoo	1,707	2.01	1,707	2.24								
Kalkaska	168	.20										
Kent	6,793	8.00	6,793	8.95	6,793	80.38						
Keweenaw	17	.02										
Lake	40	.05										

(continued)

HEAVY-DUTY TRUCK POPULATION (Continued)
YEAR - 1977

	MOTOR VEHICLE POPULATION											
COUNTY	Statewide	%	Nonattainment Counties	%	Grand Rapids	%	Lansing	%	Flint	%	Detroit	%
Lapeer	659	.78	659	.87								
Leelanau	160	.19										
Lenawee	1,129	1.33	1,129	1.49								
Livingston	593	.70	593	.78								
Luce	73	.09										
Mackinac	80	.09										
Macomb	4,506	5.31	4,506	5.94							4,506	12.78
Manistee	173	.20										
Marquette	503	.59	503	.66								
Mason	231	.27										
Mecosta	212	.25										
Menominee	429	.51										
Midland	464	.55	464	.61								
Missaukee	135	.16										
Monroe	1,386	1.63	1,386	1.83							1,386	3.93
Montcalm	485	.57	485	.64								
Montmorency	78	.09										
Muskegon	1,431	1.69	1,431	1.88								
Newaygo	352	.41										
Oakland	7,627	8.99	7,627	10.05							7,627	21.63
Oceana	197	.23										
Ogemaw	165	.19										
Ontonagon	82	.10										
Osceola	212	.25										
Oscoda	47	.06										
Otsego	219	.26										
Ottawa	1,658	1.95	1,658	2.18	1,658	19.62						
Preseque Isle	152	.18										
Roscommon	94	.11										
Saginaw	2,512	2.96	2,512	3.31								
St. Clair	1,248	1.47	1,248	1.64								
St. Joseph	750	.88	750	.99								
Sanilac	677	.80	677	.89								
Schoolcraft	98	.12										
Shiawassee	650	.77	650	.86								
Tuscola	1,070	1.26	1,070	1.41								
Van Buren	574	.68	574	.76								
Washtenaw	1,407	1.66	1,407	1.85							1,407	3.99
Wayne	20,336	23.96	20,336	26.79							20,336	57.67
Wexford	259	.31										
Foreign	--	--										
Total	84,869	100	75,917	100	8,451	100	3,573	100	3,415	100	35,262	100

MOTORCYCLE POPULATION
YEAR - 1977

	MOTOR VEHICLE POPULATION											
	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
COUNTY	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%
Alcona	.27	0.1										
Alger	.34	0.1										
Allegan	2.45	1.0	2.45	1.1								
Alpena	1.10	0.4										
Antrim	.56	0.2										
Arenac	.38	0.2										
Baraga	.30	0.1										
Barry	1.73	0.7	1.73	0.8								
Bay	3.12	1.3	3.12	1.4								
Benzie	.34	.1										
Berrien	4.56	1.8	4.56	2.1								
Branch	1.38	0.6	1.38	0.6								
Calhoun	4.63	1.9	4.63	2.1								
Cass	1.94	0.8	1.94	0.8								
Charlevoix	.78	0.3										
Cheboygan	.78	0.3										
Chippewa	1.11	0.4										
Clare	.68	0.3										
Clinton	2.28	0.9	2.28	1.0			2.28	16.8				
Crawford	.30	0.1										
Delta	1.19	0.5										
Dickinson	.99	0.4										
Eaton	3.14	1.3	3.14	1.4			3.14	23.2				
Emmet	.83	0.3										
Genesee	12.82	5.2	12.82	5.9					12.82	100		
Gladwin	.53	0.2										
Gogebic	.48	0.2										
Gd. Traverse	1.79	0.7										
Gratiot	1.74	0.7	1.74	0.8								
Hillsdale	1.53	0.6	1.53	0.7								
Houghton	.89	0.4										
Huron	1.16	0.5	1.16	0.5								
Ingham	8.12	3.3	8.12	3.7			8.12	60				
Ionia	2.19	0.9	2.10	1.0								
Iosco	.94	0.4										
Iron	.41	0.2										
Isabella	1.29	0.5										
Jackson	4.82	1.9	4.82	2.2								
Kalamazoo	6.70	2.7	6.70	3.1								
Kalkaska	.27	0.1										
Kent	13.77	5.6	13.77	6.3	13.77	72.7						
Keweenaw	.83	0.0										
Lake	.17	0.1										

(continued)

MOTORCYCLE POPULATION (Continued)
YEAR - 1977

	MOTOR VEHICLE POPULATION											
	Statewide		Nonattainment Counties		Grand Rapids		Lansing		Flint		Detroit	
COUNTY	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%	x 10^3	%
Lapeer	2.43	1.0	2.43	1.1								
Leelanau	.36	0.1										
Lenawee	3.06	1.2	3.06	1.4								
Livingston	2.82	1.1	2.82	1.3								
Luce	.18	0.1										
Mackinac	.35	0.1										
Macomb	16.91	6.8	16.91	7.7							16.91	17.9
Manistee	.61	0.2										
Marquette	2.80	1.1	2.80	1.3								
Mason	.97	0.4										
Mecosta	.75	0.3										
Menominee	.82	0.3										
Midland	2.30	0.9	2.30	1.1								
Missaukee	.35	0.1										
Monroe	4.13	1.7	4.13	1.9							4.13	4.4
Montcalm	1.76	0.7	1.76	0.8								
Montmorency	.24	0.1										
Muskegon	5.15	2.1	5.15	2.4								
Newaygo	1.37	0.6										
Oakland	24.73	10.0	24.73	11.3							24.73	26.1
Oceana	.75	0.3										
Ogemaw	.50	0.2										
Ontonagon	.26	0.1										
Osceola	.64	0.3										
Oscoda	.23	0.1										
Otsego	.52	0.2										
Ottawa	5.15	2.1	5.15	2.3	5.15	27.2						
Presque Isle	.44	0.2										
Roscommon	.55	0.2										
Saginaw	5.77	2.3	5.77	2.6								
St. Clair	4.15	1.7	4.15	1.9								
St. Joseph	2.20	0.9	2.20	1.0								
Sanilac	1.43	0.6	1.43	0.7								
Schoolcraft	.35	0.1										
Shiawassee	2.90	1.2	2.90	1.3								
Tuscola	1.98	0.8	1.98	1.0								
Van Buren	2.03	0.8	2.03	0.9								
Washtenaw	6.77	2.7	6.77	3.1							6.77	7.1
Wayne	42.09	17.0	42.09	19.3							42.09	44.5
Wexford	.93	0.4										
Foreign	.16	0.1										
Total	247.42	100	218.64	100	18.92	100	13.54	100	12.82	100	94.63	100

APPENDIX B

LEGISLATIVE CONSIDERATIONS

APPENDIX B

LEGISLATIVE CONSIDERATIONS

B.1 INTRODUCTION

Well-designed legislation is needed in any area to properly implement any program or to create the authority to carry out particular responsibilities. The purpose of the following appendix is to review legislation in effect in the State of Michigan and to determine the applicability of such legislation to the implementation of an I/M program. The enabling legislation for such a program will be developed in part by reviewing existing legislation to determine the need for and extent of additional legislation.

The basic approach used in analyzing the legislative issues and requirements consist of a review of (1) existing Michigan legislation, and (2) results of studies by state legislatures that have implemented existing I/M programs. This review provides excerpts from example state legislation to indicate certain important dimensions that should be incorporated in any proposal. Obviously, the eventual legislation and implementation authority rests with officials of the State of Michigan.

B.2 EXISTING MICHIGAN LEGISLATION

B.2.1 MICHIGAN MOTOR VEHICLE CODE: INSPECTION

The authorization for and enforcement power of the Michigan Motor Vehicle Code derives from Act No. 300 of the Public Acts of 1949, which is in part

> "....An act to provide for the registration, titling, sale and transfer, and regulation of vehicles operated upon the public highways of this state; to provide for the licensing of vehicle dealers and wreckers; to provide for the examination, licensing and control of operators and chauffeurs; to provide for the giving of proof of financial responsibility and security by owners and operators of vehicles; to provide for the imposition, levy and collection of specific taxes on vehicles, and the levy and collection of sales and use taxes, license fees and permit fees; to provide for the

> regulation and use of streets and highways; to provide penalties for violation of any of the provisions of this act; to provide for civil liability of owners and operators of vehicles and service of process on nonresidents; and to repeal all other acts or parts of acts inconsistent herewith or contrary hereto."

This act has been amended since 1949 and several sections dealing with motor vehicle operation have been added. Section 257.715 (a) and (b) deals with the inspection of vehicles and equipment. This section was enacted to enforce safety legislation, and the authority for such inspection was delegated to the Department of State Police. This section is quoted in its entirety below.

> 257.715 Inspection of vehicles and equipment. MSA 9.2415
> Amended by Public Act 510
>
> Sec. 715 (a) Equipment on motor vehicles as required under this act shall be maintained as provided in this act. Any uniformed policy officer shall be authorized on reasonable grounds shown to stop any motor vehicle to inspect the vehicle, and if any defects in equipment are found, to issue an appropriate citation under section 728 or 742 to the driver and to order the driver to have the defect or defects repaired immediately. In case of accident any policy officer may make inspection of the cars involved.
>
> (b) The director of the department of state shall cause inspection to be made of motor vehicles operating on the public highways to detect defective equipment or other violations of law governing the use of public highways by motor vehicles, operators and chauffeurs. For such purpose the director may establish temporary vehicle check lanes at appropriate locations throughout the state for checking those inadequacies and violations. A county, city, village or township police department may also operate such a temporary check lane within its limits with the express authorization of the director and under the direct supervision of a designated representative of the director.

Section 257.683 of the Public Act No. 300 deals with equipment, condition, and inspection of motor vehicles. This section was used in conjunction with Section 257.715 to enable the State Police to enforce safety requirements for vehicles and allow inspection.

257.683 Equipment, condition, inspection. MSA 9.2383

Sec. 683. (a) It is a misdeamanor for any person to drive or move or for the owner to cause or knowingly permit to be driven or moved on any highway any vehicle or combination of vehicles which is in such unsafe condition as to endanger any person, or which does not contain those parts or is not at all times equipped with such lamps and other equipment in proper condition and adjustment as required in this chapter, or which is equipped in any manner in violation of this chapter, or for any person to do any act forbidden or fail to perform any act required under this chapter.

(b) Any police officer shall be authorized on reasonable grounds shown to stop any motor vehicle and inspect the same, and if any defects in equipment are found, to arrest the driver in the manner provided in this chapter.

(c) Nothing contained in this chapter shall be construed to prohibit the use of additional parts and accessories on any vehicle not inconsistent with provisions of this chapter.

(d) The provisions of this chapter with respect to equipment on vehicles shall not apply to implements of husbandry, road machinery, road rollers, or farm tractors except as herein made applicable.

The safety inspection of motor vehicles has since been abandoned by the State of Michigan. Annual enforcement is operative only for school buses.

(Senate Bill No. 360 was passed in the regular session of 1978 and amended Section 707 (a-f) of the Act No. 300 of the Public Acts of 1949. This amendment specifically deals with the Michigan Vehicle Noise Control Act, and grants no further inspection authority to any organization.)

B.2.2 MECHANIC CERTIFICATION

The Motor Vehicle Service and Repair Act was passed in 1974 and was included as Sections 257.1301 through 257.1340. This act was established "to regulate the practice of servicing and repairing motor vehicles; to proscribe unfair and deceptive practices; to provide for training and certification of mechanics; to provide for the registration of motor vehicle repair facilities; to provide for enforcement; and to prescribe penalties."

An amendment has been proposed that the Michigan Motor Vehicle Code add Section 257.7196 which proscribes tampering with motor vehicle emission control equipment. However this possible modification of the Code is still under review by the State Legislature. The status of this bill is uncertain.

B.2.3 SUMMARY

We find that no legislation is currently in force in the State of Michigan for the operation and enforcement of an I/M program. Separate legislation would be needed, which would specify the required budget appropriation, and the delegation of authority and administrative responsibilities to a particular state department or departments, and the eventual enforcement of the law to the same and/or different departments (s). Experience has shown that an effort should still be made where possible to consolidate the new legislation into existing legislation.

B.3 LEGISLATION REVIEW: GENERAL

Several issues relevant to I/M legislation were identified during a literature review. Each issue is discussed below, first in general terms, second, in terms of extant legislation in 11 other states, and third, in terms of Michigan specifically, where appropriate. Discussion of these issues is intended only for guidance and information to Michigan's decision makers.

There were essentially 24 issues identified during review of extant legislation. The review covered all pertinent literature and documentation from around the United States. The Environmental Protection

Agency was initially contacted to obtain necessary documentation. Subsequently, State and/or local governmental units in locations where I/M legislation or an ordinance has been enacted were contacted to obtain a copy of their legislation and to solicit their comments on problems encountered. A conclusion drawn from the findings was that, at minimum, the issues listed below should be thoroughly treated in any relevant I/M legislation.

The first 20 issues should constitute a basic framework of any I/M legislation whether state-, contractor- or private garage-operated.

The last four elements identified need not be included for consideration of a state-operated program, but should be dealt with in a contractor- or private garage-operated option.

Recommended Components and Issues for Treatment in Michigan I/M Legislation

1. Authority or purpose of program
2. Definitions
3. Applicability and frequency of tests
4. Test procedures
5. Emission standards
6. Certification
7. Agency responsible for implementation
8. Licensing of personnel and equipment
9. Retest policy
10. Repair cost limits
11. Fleet inspections
12. Registration in county other than that of residence
13. Test fees
14. Time frame of implementation
15. Annual study
16. Tampering with emission control equipment

17. Penalties
18. Warranty provisions
19. Exceptions
20. Variances

(The following four additional items should be included if the State of Michigan decides to utilize a private contractor or individual garages.)

1. Authority to contract with private contractor(s)
2. Monitoring performance of private contractor(s) and/or garages
3. Conflict of interest
4. Licensing of inspection facilities

B.3.1 AUTHORITY OR PURPOSE

The basic purpose of the I/M program should be included at the beginning of the legislation, generally as a preamble. This section may also provide the statutory authority to implement an I/M program. A lead agency could be designated in this section. The two examples illustrate differing approaches to this essential component.

The first example is from the act entitled "Air Quality Regulations for Mobile Equipment" in the State of Nevada, which was approved August 16, 1978.

> WHEREAS, the Nevada State Implementation Plan shows that from the available ambient air quality data for carbon monoxide and oxidants, Clark County, specifically the Las Vegas Valley, and Washoe County, specifically the Truckee Meadows, is in violation of the State and national ambient air quality standards; and
>
> WHEREAS, such standards were promulgated by the United States Environmental Protection Agency and the State Environmental Commission for the express purpose of protecting the health and welfare of the citizens residing therein; and

> WHEREAS, the control strategy for reducing carbon monoxide and the oxidant levels by the reduction of the carbon monoxide and hydrocarbon emissions respectively includes the implementation of a strategy for inspecting and maintaining in-use motor vehicles; and
>
> WHEREAS, the Fifty-Ninth Session of the Nevada State Legislature provided guidance to the State Environmental Commission to establish an annual inspection and maintenance program in progressive steps; and
>
> WHEREAS, the State Environmental Commission now deems said inspection program necessary to aid in the achievement of the required ambient air quality standards; and
>
> WHEREAS, the Fifty-Ninth Session of the Nevada Legislature established authority for the Department of Motor Vehicles to promulgate requirements for licensing and inspecting authorized stations;
>
> NOW, THEREFORE, be it resolved that the State Environmental Commission and the Department of Motor Vehicles promulgate these regulations with the express purpose of developing data upon which to define the reductions in emissions for in-use motor vehicles and to affect a portion of the implementation plan for the reduction of emissions to aid in the achievement of the ambient air quality standards which are presently being violated predominantly because of motor vehicle emissions; and be it further resolved that such progressive step implementation is based on the requirements of Chapter 445 of NRS; and be it further resolved that a cooperative study to be completed by January 1979, such study will show acceptance by and protection of consumers, cost for improvement of air quality, and the effectiveness of the program as a whole; and be it further resolved that the motor vehicle owner will be provided with information explaining the reason for the methods of inspections.

The second example is taken from the "model I/M legislation" provided by the U.S. EPA, which sets forth the following preamble:

MODEL LEGISLATION FOR MOTOR VEHICLE POLLUTION CONTROL

"Purpose

Legislative Findings: For purposes of public health and safety, the ______________________ finds:

(1) That the emission of pollutants from motor vehicles is a significant cause of air pollution in many sections of the State of ______________________.

(2) That the control and elimination of such pollutants are of utmost importance for the protection and preservation of the public health, safety and well-being.

(3) That each state has a responsibility to establish procedures, regulations and other provisions which comply with any promulgated federal laws to control or eliminate each pollutants.

The state Environmental Agency and all other agencies, departments or divisions of said departments and agencies shall provide by rules and regulations standards, guidelines, for the inspection of all registered vehicles (with promulgated exceptions) in said state, for the purpose of controlling exhaust emissions of any air contaminants."

B.3.2 DEFINITIONS

All legislation reviewed included a separate section of definition of terms commonly associated with an I/M program, or of those terms used in the text of the specific enactment. The purpose of a definition section is to provide a clear, unambiguous meaning to some terms in order to avoid legal problems, misinterpretations or conflicts. The following section of definitions is excerpted from the State of Nevada's regulations:

ARTICLE 1 - DEFINITIONS

1.1 AMBIENT AIR: That portion of the atmosphere surrounding people, animal, and plant life.

1.2 APPROVED INSPECTOR: An individual person who has qualified by passing the written examination as prepared by the Department of Motor Vehicles, and has successfully demonstrated the ability to operate the required diagnostic equipment, and has been issued a license as an approved inspector.

1.3 AUTHORIZED STATION: As defined in subsection 1 of Chapter 445 of NRS, means, a station licensed by the Department of Motor Vehicles for inspecting motor vehicles and pollution control devices for compliance with Chapter 445 of NRS or any applicable federal or Commission regulation and for installing, repairing, and adjusting pollution control devices and motor vehicles to meet the Commission's requirements.

1.4 CARBON MONOXIDE (CO): A colorless, odorless, highly toxic gas that is a normal byproduct of incomplete fossil fuel combustion.

1.5 CERTIFICATE OF COMPLIANCE: A certificate, issued by an approved inspector in an authorized station which declares that the motor vehicle identified on the certificate is properly equipped with the pollution control devices indicated on the certificate that such devices conform with the requirements of Chapter 445 of NRS and rules and regulation as adopted by the State Environmental Commission.

1.6 COMMISSION: The State Environmental Commission, as defined in Chapter 445 of NRS.

1.7 CRANKCASE EMISSIONS: Air contaminants emitted into the atmosphere from any portion of the engine crankcase ventilation or lubrication systems.

1.8 DEPARTMENT: The Department of Motor Vehicles.

1.9 DIAGNOSTIC EQUIPMENT: Tools used to diagnose engine performance.

1.10 EMISSION: The act of passing into the atmosphere an air contaminant or a gas stream which contains, or may contain, an air contaminant; or the material passed to the atmosphere.

1.13 EXHAUST EMISSIONS: Air contaminants emitted into the atmosphere from any opening downstream from the exhaust ports of a motor vehicle engine.

1.14 EXHAUST GAS ANALYZER: A device for sensing the amount of air contaminants in the exhaust emissions of a motor vehicle.

1.15 FLEET OWNER: An owner or lessee of three or more motor vehicles.

1.16 FLEET STATION: as defined in subsection 4 of Chapter 445.610 of NRS, means a facility which is licensed by the Department to conduct inspections of the motor vehicles of qualified owners or lessees.

1.17 **GROSS VEHICLE WEIGHT:** The manufacturer's gross weight rating for the individual motor vehicle.

1.18 **HEAVY-DUTY MOTOR VEHICLE:** A gasoline fueled motor vehicle whose GVW is greater than 2,721 kilograms (6,000 pounds).

1.19 **HYDROCARBONS:** A family of compounds containing carbon and hydrogen in various combinations, found especially in fossil fuel.

1.20 **INSPECTION/MAINTENANCE:** A strategy to reduce emissions from in-use motor vehicles by identifying vehicles that need emissions-related maintenance and requiring that such maintenance be performed.

1.21 **LIGHT-DUTY MOTOR VEHICLE:** A passenger car or passenger car derivative capable of seating 12 persons or less and having a GVW rating of 2,721 kilograms (6,000 pounds) or less; or a motor vehicle designed primarily for the transportation of property, or the derivation of such a vehicle, having a GVW rating of 2,721 kilograms (6,000 pounds) or less.

1.25 **NEW MOTOR VEHICLE:** A motor vehicle that has never been registered with the Department, and has never been registered with the appropriate agency of authority of any other state, the District of Columbia, any territory or possession of the United States or foreign state, province, or country.

1.26 **NITROGEN OXIDES:** A gas formed in great part from atmospheric nitrogen and oxygen when combustion takes place under high temperature and high pressure, as in internal combustion engines. All oxides of nitrogen except nitrous oxide, which is not considered toxic at ambient concentrations, as measured by test methods set forth in this part.

1.29 **REGISTERED OWNER:** An individual, firm, corporation, or association whose name appears in the files of the motor vehicle registration division of the Department of Motor Vehicles as the person to whom the motor vehicle is registered.

1.34 **TAMPERING:** Rendering inoperative, or intentional misadjustment of any motor vehicle device or element of design intended to control exhaust emissions.

1.37 **WAIVER:** A document which would permit registration of a vehicle that does not meet the emission standard as set forth by the State Environmental Commission, and is issued only by the Department of Motor Vehicles, which shall expire one year from the date of issuance.

1.38 The abbreviations used in these regulations have the following meanings:

°C - degree celsius (centigrade)
CO - carbon monoxide
GVW - gross vehicle weight
HC - hydrocarbons
kg - kilogram (s)
lb - pound (s)
NO_x - nitrogen oxides
ppm - parts per million

The number of definitions provided by the Nevada regulations may be considered excessive (fewer than half the total appear above). However, any section of definitions should be as comprehensive as the scope of the enactment requires.

B.3.3 APPLICABILITY AND FREQUENCY OF INSPECTIONS

This issue covers three separate elements: geographical area in which the program is to be operated, class(es) of vehicles to be covered, and the frequency at which these vehicles must be tested. Most of the legislation reviewed limited the geographical area of coverage to within the commonly understood political boundary lines of counties, cities, or for the entire state. Some states have established urban area population thresholds below which an area would not qualify for program implementation owing to the presumption of limited program effectiveness in less densely populated areas.

State of Arizona House Bill 2319, Chapter 158, states that "the Director shall administer a comprehensive annual emissions inspection program which shall require the inspection of vehicles in this state in accordance with the provisions of law or administrative regulations pursuant to this article. Such inspection shall commence in counties with a population in excess of 350,000 by January 1, 1976. Inspection in other counties of the state will commence when required by the director to meet air pollution control standards or upon application by a county board of supervisors for participation in such inspection programs, subject to approval by the Director."

Setting the threshold at 350,000 population automatically provides for the inclusion of other areas as population grows. The State of Michigan, in order to limit the geographic range of an I/M program, might consider a simple statement such as "This program is applicable to (vehicles categories) in the counties of ____________ in the State of Michigan."

In addition to defining the geographical coverage of the I/M program, the enabling legislation must specify the type of vehicles to be included in the program. The study presently underway should provide guidance to state officials toward reaching a decision on vehicle coverage. In the legislation reviewed, vehicle types are generally separated on the basis of gross vehicle weight (GVW). The following categories are generally utilized:

LDV - light-duty vehicles (all passenger cars)
LDT1 - light-duty trucks with GVW less than 6,001 lbs
LDT2 - light-duty trucks with GVW greater than 6,000 but less than 8,501 lbs.
HDD - diesel-fuel-powered trucks of greater than 8,500 lbs GVW

In addition to those for vehicle coverage, most states with I/M have provisions for used autos sold by dealers, autos sold by one individual to another, new autos, and autos belonging to residents moving into the affected geographical area from outside the area. Moreover, most states require that if a vehicle in a category subject to testing is sold by one party to another, evidence of inspection must be presented prior to the completion of the title change. In the event a test certificate has expired, no new title will be issued until the car is inspected and a new certificate issued.

Vehicles owned by an individual moving into the covered geographical area may be processed as new cars. The State of Nevada's legislation dealt with this problem by including a statement which in part reads:

- In accordance with Chapter 445 of NRS, on or after July 1, 1977, all used light-duty motor vehicles being registered to a new owner or being registered for the first time are required to have evidence of compliance, in Clark County.

- In accordance with Chapter 445 of NRS, on or after July 1, 1979, all used light-duty motor vehicles being registered or reregistered are required to have evidence of compliance, in Clark County.

The procedures cited assume that vehicle registration will be the mechanism utilized for enforcement.

The last element to be addressed here is the frequency at which a vehicle should be tested. It is shown elsewhere in this report that tailpipe emissions are lowest after an inspection. The emissions deterioration curve (rate of increasing emissions) gradually rises over time until about the ninth or tenth month after inspection, at which point it has reached or surpassed preinspection emission intensity levels. It is from this standpoint, and as a matter of practicality, that most programs have settled on an annual inspection cycle. Usually, this annual inspection is integrated with motor vehicle registration, thereby combining requirements and resulting in a lower outlay than would be required by a nonintegrated program.

B.3.4 TEST PROCEDURES

The legislation review revealed divergent approaches to the adoption of test procedures. Some states have not addressed this issue at all, effectively leaving definition and implementation of the actual procedures to the authority of a department or a director. Conversely, other states have gone to considerable length to lay out the process step-by-step. Differing approaches are shown in the two examples that follow.

Example one, from New Jersey, contains a simple, relatively non-specific process description. Example two, from the State of Oregon, provides step by step instructions for testing.

EXAMPLE ONE

Prescribed Inspection Test Procedure

STEP 1: All measurements are to be made after engine has been operating a sufficient period of time to attain normal operating temperature.

STEP 2: With the vehicle in neutral gear, all accessories off, handbrake secured, accelerate engine and observe for continuous visible smoke in the crankcase emissions after vehicle has reached a steady state condition.

STEP 3: With the engine running at idle, insert sample probe of gas analytical system into the engine exhaust outlet. The steady state levels measured as percent carbon monoxide and parts per million of hydrocarbons in the exhaust gas shall be the inspection test result.

EXAMPLE TWO

24-310 Light-Duty Motor Vehicle Emission Control Test Method

(1) The vehicle emission inspector is to ensure that the gas analytical system is properly calibrated prior to initiating a vehicle test.

(2) The Department approved vehicle information data form is to be completed at the time of the motor vehicle being inspected.

(3) Vehicles having coolant, oil or fuel leaks or any other such defect that is unsafe to allow the emission test to be conducted shall be rejected from the testing area. The emission test shall not be conducted until the defects are eliminated.

(4) The vehicle is to be in neutral gear if equipped with a manual transmission, or in "park" position if equipped with an automatic transmission.

(5) All vehicle accessories are to be turned off.

(6) An inspection is to be made to ensure that the motor vehicle is equipped with the required functioning motor vehicle pollution control system in accordance with the criteria of section 24-320(3). Vehicles not meeting this criteria shall be rejected from the testing area without an emission test. A report shall be supplied to the driver indicating the reason(s) for rejection.

(7) With the engine operating at idle speed, the sampling probe of the gas analytical system is to be inserted into the engine exhaust outlet.

(8) The steady-state levels of the gases measured at idle speed by the gas analytical system shall be recorded. Except for diesel vehicles, the idle speed at which the gas measurements were made shall also be recorded.

(9) Except for diesel vehicles, the engine is to be accelerated with no external loading applied, to a speed of between 2,200 and 2,700. The engine speed is to be maintained at a steady speed within this speed range for a 4 to 8 second period and then returned to an idle speed condition. In the case of a diesel vehicle, the engine is to be accelerated to an above idle speed. The engine speed is to be maintained at a steady above idle speed for a 4 to 8 second period and then returned to an idle speed condition.

(10) The steady state levels of the gases measured at idle speed by the gas analytical system shall be recorded. Except for diesel vehicles, the idle speed at which the gas measurements were made shall also be recorded.

(11) If the vehicle is equipped with a multiple exhaust system, then steps (7) through (10) are to be repeated on the other exhaust outlet(s). The readings from the exhaust outlets are to be averaged into one reading for each gas measured for comparison to the standards of section 24-330.

(12) If the vehicle is capable of being operated with both gasoline and gaseous fuels, then steps (7) through (10) are to be repeated so that emission test results are obtained for both fuels.

(13) If it is ascertained that the vehicles may be emitting noise in excess of the noise standards adopted pursuant to ORS 467.030, then a noise measurement is to be conducted in accordance with the test procedures adopted by the Commission or to standard methods approved in writing by the Department.

(14) If it is determined that the vehicle complies with the criteria of section 24-320 and the standards of section 24-330, then, following receipt of the required fees, the vehicle emission inspector shall issue the required certificates of compliance and inspection.

(15) The inspector shall affix any certificate of inspection to the lower left-hand side (normally the driver's side) of the front windshield, being careful not to obscure the vehicle identification number nor to obstruct driver vision.

(16) No certificate of compliance or inspection shall be issued unless the vehicle complies with all requirements of these rules and those applicable provisions of ORS 468.360 to 468.405, 481.190 to 481.200, and 483.800 to 483.825.

B.3.5 EMISSION STANDARDS

There is an inverse relationship between I/M program stringency factors and permissible emissions per vehicle. As stringency is increased (0 to 50 percent),emission cutpoints are lowered, thereby increasing failure rate. Conversely, as stringency is decreased (50 to 0 percent), emission standards are relaxed, thereby decreasing the failure rate.

There are essentially two methods of setting standards cutpoints. The first method is to delegate authority to a particular agency or individual. This is the case of the State of Arizona, in which I/M legislation stipulates that "the director shall adopt minimum emissions standards pursuant to section 36-1717 with which the various classes of vehicles shall be required to comply after January 1, 1977.

For the purpose of determining compliance with minimum emissions standards, vehicles shall be required to pass only the idle test condition. The loaded test condition shall be administered at the official emissions inspection stations for diagnostic purposes only. Vehicles which fail the idle test solely because of air gas mixture shall be entitled to a certificate of waiver upon correction of the problem, after having furnished satisfactory evidence of correction to the director on a form to be prescribed by the director."

This clause empowers the Director of the Bureau of Vehicular Emissions Inspections to revise the standards upward or downward depending on the actual testing results, number of cars failed, and the state of new technology.

In the second method, standards are incorporated into the legislation itself. This could involve establishing cutpoints specific to the type and model year of the vehicle, which ensures that the program is equitable in the sense that older, less controlled cars are subject to more lenient standards than late model vehicles. A somewhat more inclusive criterion for establishing cutpoints is recommended by EPA in its draft legislation. Cutpoints are classified by vehicle model year according to the type of test implemented. The following cutpoints are suggested by the EPA:

IDLE EMISSIONS TEST

Model Year	Maximum Allowable	
	HC (ppm)	CO (%)
Pre-1968	1,000	6.0
1968-69	600	5.0
1970-74	500	4.0
Post-1974	150	1.5

LOADED EMISSIONS TEST

Model Year	Number of Cylinders	Maximum Allowable HC (ppm) and CO (%)					
		Idle		Low Cruise		High Cruise	
		HC	CO	HC	CO	HC	CO
Pre-1968	4 or less	1300	8.0	1000	6.0	1000	5.0
	5 or more	1000	6.0	700	5.2	700	4.2
1968-69	4 or less	800	6.0	600	4.2	600	3.8
	5 or more	600	5.0	400	3.5	400	3.0
1970-74	4 or less	550	5.0	400	3.5	400	3.0
	5 or more	500	4.0	350	3.0	350	2.5
Post 1974	4 or less	150	1.5	120	1.0	100	0.9
	5 or more	150	1.5	120	1.0	100	0.9

Whatever the approach taken for establishing cutpoints, it is suggested that this aspect be studied in greater detail. Stringent standards spread the burden of repair costs over a large number of vehicle owners, and may increase the frequency of consumer complaints despite a lower average per-vehicle repair cost. On the other hand, relaxed standards result in lower total repair costs to the driving public, but the "gross emitters" identified in the program may suffer very high average per-vehicle repair liabilities. Because these drivers may tend to be relatively disadvantaged economically, questions about the social equity of the program can arise.

B.3.6 CERTIFICATION

Certification is necessary to the succesful implementation of any I/M program. It ensures compliance with laws and regulations by motor vehicle owners. The instruments most commonly used to certify passage of emission requirements are vehicle stickers and the annual registration process. A majority of states with programs utilize the registration method as an effective enforcement technique. This mechanism obligates the individual to an emissions test prior to the renewal of his vehicle's operating license. In the event of an unrepaired failure, or failure to get the car tested, sanctions are brought into play.

For example, Senate Bill No. 231, enacted by the General Assembly of the State of Colorado, makes the following provisions:

> 42-4-312. Periodic emissions inspection required. (1) Beginning January 1, 1980, those motor vehicles specified in section 42-4-307 (4), for the model year 1977 and later models, which are registered in the counties of Adams, Arapahoe, Boulder, Denver, Douglas, El Paso, Jefferson, Larimer, and Weld shall be inspected once each year at twelve-month intervals, and an official certificate of emissions compliance shall be obtained for and displayed by each vehicle, except as otherwise provided in subsection (3) of this section.
>
> (2) Those motor vehicles required to be inspected under subsection (1) of this section shall be initially inspected during the calendar year in which inspection is first required as provided in subsection (1) of this section, and such motor vehicles shall then be required to obtain a certificate of emissions compliance. The executive director shall promulgate regulations to provide for the scheduling of said emissions inspections for said vehicles in approximately equal numbers during said calendar year and may provide for expiration dates applicable thereto.
>
> (3) New motor vehicles required by subsection (1) of this section to obtain the certificate of emissions compliance shall be issued such a certificate, without inspection, to expire in the twelfth month after delivery or initial vehicle registration. Prior to said expiration, said vehicles shall be required to be inspected and to obtain a certificate of emissions compliance which shall expire in the twelfth month after the month of inspection.
>
> (4) Each certificate of emissions compliance shall be obtained during the calendar month respectively assigned. The certificate of emissions compliance shall be issued to expire in the twelfth month after the month of inspection, so that every motor vehicle registered in the designated counties shall be inspected during its assigned month in each calendar year.

(5) The emissions inspection required under this section shall include an analysis of tailpipe exhaust gas emissions by means of an idle mode test to determine compliance with applicable exhaust gas emissions regulations adopted by the commission.

(6) Effective January 1, 1980, or later if so scheduled by regulations of the department, every motor vehicle of the model year 1977 or later registered in this state in a county not specified in subsection (1) of this section may be required, at least once each year at twelve-month intervals, to obtain and display a certificate of emissions exemption, but said vehicle shall not be required to be inspected therefor. In addition to the issuance thereof by emissions inspection station licensees, the executive director shall by regulation provide for the issuance, by licensed safety inspectors or by other means, of said certificates under this subsection (6). The executive director also may, by rule and regulation, prescribe methods of identifying pre-1977 model year vehicles not readily distinguishable from vehicles affected by this section.

(7) Every motor vehicle specified in subsections (1), (3), and (6) of this section shall be required to obtain and display a currently valid certificate of emissions inspection, as defined in section 42-4-307 (2), in such a position as to be visible from the outside of the vehicle and located on the vehicle in accordance with the rules and regulations of the department.

(8) The department may suspend the registration of any motor vehicle required to be inspected for emissions for which a certificate of emissions compliance has not been obtained.

B.3.7 AGENCY RESPONSIBLE FOR IMPLEMENTATION

Identification of the agency or agencies responsible for program implementation could be addressed either in the Authority section of an I/M bill or under its own separate heading. An existing department (e.g., "Michigan Department of Transportation") could be designated the sole lead agency, or specific responsibility could be allocated among different departments (Department of Transportation, State Police, Attorney General, etc.). A third option does exist: creation of a new department solely for this purpose. The last option might be difficult to implement due to growing public concern over the increase in government bureaucracy.

Most I/M states and localities have opted to delegate implementation responsibility to an existing department. The State of Rhode Island provides in its legislation that "....on and after November 1, 1977, the Director of Transportation shall at least once each year, but not more frequently than twice each year, require that every vehicle, trailer, semi-trailer, or pole trailer registered in this state or upon a retail seller's premises be inspected and that an official certificate of inspection and approval be obtained for each such vehicle...."

B.3.8 LICENSING OF PERSONNEL AND EQUIPMENT

Legislative detail on the specifics of this issue varies from state to state. Some I/M legislation specifies licensing, training, and monitoring of inspectors and the equipment used to test vehicles. Other states leave this activity to the discretion of the designated implementing agency. An example of provision for the licensing of inspectors is contained in the Oregon legislation, excerpted below.

> 24-340 CRITERIA FOR QUALIFICATION OF PERSONS ELIGIBLE TO INSPECT MOTOR VEHICLES AND MOTOR VEHICLE POLLUTION CONTROL SYSTEMS AND EXECUTE CERTIFICATES
>
> (1) Three separate classes of licenses are established by these rules.
>
> (a) Motor vehicle fleet operations
> (b) Fleet operation vehicle emission inspector
> (c) State employed vehicle emission inspector

(2) Application for a license must be completed on a form provided by the department.

(3) Each license shall be valid for 12 months following the end of the month of issuance unless revoked, suspended, or returned to the Department.

(4) No license shall be issued until the applicant has fulfilled all requirements and paid the required fee.

(5) No license shall be transferable.

(6) Each license may be renewed upon application and receipt of renewal fee if the application for renewal is made within the 30 day period prior to the expiration date and the applicant complies with all other licensing requirements.

(7) A license may be suspended, revoked, or not renewed if the licensee has violated these rules or ORS 468.360 to 468.405, 481.190 or 483.800 to 483.820.

(8) A fleet operation vehicle emission inspector license shall be valid only for inspection of, and execution of certificates for, motor vehicle pollution control systems and motor vehicles or the motor vehicle fleet operation by which the inspector is employed on a full-time basis, except as provided in subsection (a).

(a) A fleet operation vehicle emission inspector employed by a governmental agency may be authorized by the Department to perform inspections and execute Certificates of Compliance for vehicles of other governmental agencies that have contracted with that agency for that service and that contract having the approval of the Director.

(9) To be licensed as a vehicle emission inspector, the applicant must:

(a) Be an employee of the Vehicle Inspection Division of the department, or

(b) Be an employee of a licensed motor vehicle fleet operation.

(c) Complete application.

(d) Satisfactorily complete a training program conducted by the department. Only persons employed by the department or by a motor vehicle fleet operation shall be eligible to participate in the training program unless otherwise approved by the Director. The duration of the training program for persons employed by a motor vehicle fleet operation shall not exceed 24 hours.

(e) Satisfactorily complete an examination pertaining to the inspection program requirements. This examination shall be prepared, conducted, and graded by the department.

(10) To be licensed as a motor vehicle fleet operation, the applicant must:

(a) Be in ownership, control, or management, or any combination thereof of 100 or more Oregon registered in-use motor vehicles, or 50 or more publicly owned vehicles registered pursuant to ORS 481.125.

(b) Be equipped with an exhaust gas analyzer complying with criteria established in section 24-350 of these rules.

(c) Be equipped with a sound level meter conforming to "Requirements for Sound Measuring Instruments and Personnel" (NPCS-2) manual, revised September 15, 1974, of this department.

(11) No person licensed as a motor vehicle fleet operation shall advertise or represent himself as being licensed to inspect motor vehicles to determine compliance with the criteria and standards of sections 24-320 and 24-330.

A similar requirement may be included in the licensing of test equipment. The State of Oregon legislation contains the most comprehensive licensing requirement found in the review. The relevant section is provided below as an example of the degree of detail possible on this issue.

24-350 GAS ANALYTICAL SYSTEM LICENSING CRITERIA

(1) To be licensed, an exhaust gas analyzer must:

(a) Conform substantially with either:

(A) All specifications contained in the document for Exhaust Gas Analyzer System Including Engine Tachometers" dated July 9, 1974, prepared by the department and on file in the office of the Vehicle Inspection Division of the department, or

(B) The technical specifications contained in the document "Performance Criteria, Design Guidelines, and Accreditation Procedures For Hydrocarbon (HC) and Carbon Monoxide (CO) Analyzers Required in California Official Motor Vehicle Pollution Control Stations", issued by the Bureau of Automotive Repair, Department of Consumer Affairs, State of California, and on file in the office of the Vehicle Inspection Division of the department. Evidence that an instrument model is approved by the California Bureau of Automotive Repair will suffice to show conformance with this technical specification.

(b) Be owned by the licensed motor vehicle fleet operation or the Department.

(c) Be span gas calibrated a minimum of once a month (at least every 30 calendar days) by a licensed inspector. The calibration and the inspector's initials are to be recorded on the back of the exhaust gas analyzer's license for verification by the department.

(2) Application for a license must be completed on a form provided by the department.

(3) Each license issued for an exhaust gas analyzer system shall be valid for 12 months following the end of the month of issuance, unless returned to the department or revoked.

(4) A license for an exhaust gas analyzer system shall be renewed upon submission of a statement by the motor vehicle fleet operation that all conditions pertaining to the original license issuance are still valid and that the unit has been gas calibrated and its proper operation verified within the last 30 days by a vehicle emission inspector in their employment.

(5) Grounds for revocation of a license issued for an exhaust gas analyzer system include the following:

(a) The unit has been altered, damaged, or modified so as to no longer conform with the specifications of subsection (1)(a) of this section.

(b) The unit is no longer owned, controlled, or managed by the motor vehicle fleet operation to which the license was issued.

(c) The department verifies that a Certificate of Compliance has been issued to a vehicle which has been emission tested by an analyzer that has not met the requirements of subsection (1)(c) of this section.

(6) No license shall be transferable.

(7) No license shall be issued until all requirements of subsection (1) of this section are fulfilled and required fees paid.

B.3.9 RETEST POLICY

This policy addresses the retest of cars that have failed to meet the established emission standards. Most states deal with test failures by having failed vehicles return for retesting after appropriate maintenance within a prescribed time period such as 30 days. A decision must be reached as to whether retest is to be provided free of charge, or an additional fee is to be charged for this "second chance." It was found that most I/M states, in order to minimize consumer resistance,allow a free retest within the prescribed time period.

Rhode Island has included the following phrase in its legislation: "Any person whose vehicle has been inspected at an official inspection station, shall, if such vehicle was not found to comply with the minimum standards, have his vehicle repaired and have the right within twenty (20) consecutive days, but not thereafter, to return such vehicle for one (1) reinspection without charge."

Arizona legislation allows a somewhat longer period (30 days), but reads essentially the same: "Any person whose vehicle has been inspected at an official inspection station, shall, if such vehicle was not found to comply with the minimum standards, have his vehicle repaired and have the right within 30 consecutive calendar days, but not thereafter, to return such vehicle for one reinspection without charge."

In general, a second failure results either in a waiver of further testing requirements or a stipulation that the vehicle owner must pay for a second and, if needed, subsequent retests.

B.3.10 REPAIR COST LIMIT

It is politically prudent and may enhance social equity to impose "ceiling" on the cost of the repairs necessary to bring a vehicle into compliance with test standards. This limit should prevent excessive financial hardship for low income drivers. In some instances, the cost of repairing a vehicle exceeds the vehicle's NADA Blue Book value. A repair cost limit also precludes the premature retiring of certain vehicles.

A cost ceiling may be expressed in one of two ways, either as a fixed value ($50, $75, or $100), or as a fixed percentage of the vehicle's current market value. The State of New Jersey places the following limit on the repair of a vehicles for emission purposes.

> (b) Whenever the estimated cost of emission compliance for reinspection exceeds one hundred dollars ($100) for a vehicle 10 years or older, the owner of such vehicle may apply to the Department for a waiver of compliance presenting the vehicle repair cost estimate from a licensed reinspection center. Such application must include vehicle license, make, year, date, reinspection center and mechanic's name.

B.3.11 FLEET INSPECTIONS

Fleets include vehicles in generic categories such as taxi-cabs, rental vehicles, state vehicles, police vehicles, and any other groups of vehicles which, as a class, are owned by private concerns or government. If the number of vehicles in a particular fleet is quite large, it may be more cost-effective to have the fleet operator certify all vehicles under his charge rather than to have each individual vehicle driven to a testing station. However, a criterion should be established for certifying fleet vehicle inspectors in order to insure a proper implementation of the intent of the law.

Most I/M states have provided a section of legislation that deals with the inspection of fleet vehicles. Generally, a fleet is classified as having over 15 vehicles. However, one state considers that as few as three vehicles constitute a fleet. Each of the states justifies its provision for certified inspection by fleet owners on the basis of the desire to minimize inconvenience to these owners and to reduce the number of facilities needed. However, each state realizes that an essential element in the success of its fleet inspection program is adequate supervision and related quality assurance. Each of the states has made provision for licensing of fleet inspection facilities, surveillance procedures, and revocation of permit.

The State of Rhode Island's approach is shown below.

> 31-38-13. FLEET OPERATORS. - Every person who shall provide maintenance facilities for the servicing of vehicles used in his business except licensed motor vehicle dealers, which facilities shall be approved by the Director of the Department of Transportation, and shall maintain such records and follow such procedures as shall be established by the Director, shall be qualified as an official inspection station for such vehicles. Such person shall not issue inspection certificates for any vehicle not used in the operation of such business.

The State of Arizona is much more circumspect in its regulation of fleet inspections. Chapter 158 of House Bill 2319 lists the following requirements for fleet inspections:

36-1776. Fleet emissions inspection stations; certificates of inspection; dealer's inventory; investigations; revocation of permit

A. Any registered owner or lessee of a fleet of at twenty-five vehicles may apply to the director for a permit to establish a fleet emissions inspection station. The director shall not issue any fleet emissions inspection station permit until he has found that the applicant:

1. Maintains an established place of business for the repair and maintenance of applicant's fleet of vehicles.
2. Has obtained approved machinery, tools and equipment to adequately conduct the required emissions inspections.
3. Employs properly trained and licensed personnel with which to perform the necessary labor.
4. Agrees to provide data as may be prescribed by the director.

B. Any operator of a fleet emissions inspection station under a valid permit shall, upon filing an application in the manner and form prescribed by the director and paying the prescribed fee, receive a sufficient number of certificates of inspection for each vehicle in applicant's fleet. No certificate of inspection shall be placed on or affixed to any fleet vehicle until it has been inspected and found to comply with all the minimum standards that such vehicle would be required to meet at any official emissions inspection station.

C. No holder of a fleet emissions inspection station permit shall inspect or certificate any vehicle for which such permittee is not the registered owner or lessee, unless authorized by the director.

D. Vehicles owned by a licensed vehicle dealer and which are held for resale as a part of the dealer's business inventory shall be deemed a part of such dealer's vehicle fleet for purposes of this section.

> E. Every vehicle over eight thousand pounds subject to the provisions of this section and registered in this state shall be inspected in accordance with the provisions of this article at least once within each twelve-month period following any original registration or reregistration. A vehicle shall not be reregistered until such vehicle has passed inspection.
>
> F. The director shall investigate the operation of each fleet emissions inspection station as the conditions and circumstances of such operation may indicate. He may require the holder of any fleet permit to submit such documentation required concerning the operation of such inspection station. The director may revoke and require the surrender and forfeiture of any fleet emissions inspection station permit and certificates of inspection of such permittee if he finds that such station is not operated in accordance with this article and the lawful rules and regulations adopted by the director or the holder of such permit has failed or refused to submit records or documentation required.

B.3.12 REGISTRATION IN COUNTY OTHER THAN THAT OF RESIDENCE

If the coverage of this program is not statewide and is limited to certain counties, instances could result in which individuals or fleet owners register their vehicles in a county other than that of residence in order to circumvent the inspection requirement and thus undermine the purpose of the I/M program. This problem could be alleviated by including a penalty provision in the legislation.

The State of Arizona has done this in section 28.301.01 of its Act:

> "Any person who registers a motor vehicle belonging to him in a county other than the county where he maintains his permanent and actual residence with intent to evade the provisions of this article is guilty of a misdemeanor; and any county assessor who registers a motor vehicle illegally for a person not residing in the county shall transfer any and all monies collected and retained by the county in connection with such registration to the county assessor of the county of such person's permanent and actual residence."

B.3.13 FEES

Inspection fees are usually based on the premise that the fee should be sufficient to cover the cost incurred to the state and/or contractor plus, in the latter instance, a small profit. This fee structure is therefore intended to assure program self-sufficiency.

Most states set a maximum fee for performing a vehicle inspection. This fee usually allows for the cost of reinspection of an assumed proportion of vehicles. Arizona specifies the fee ceiling that will be charged for inspection in the I/M legislation itself:

> "Emission Inspection Fees; Composition and Disposition
>
> A. The director shall fix, regulate and alter in accordance with this section, the fees, not to exceed five dollars per inspection, required to be paid for the inspection of every vehicle inspected pursuant to this article.
>
> B. The director shall fix the fees, not to exceed five dollars per inspection. Such fees shall be originally fixed and thereafter adjusted by the director to reflect the contractual charge payable in costs to the state of providing and administering emissions inspection services.
>
> C. The fees charged for official emissions inspection shall be uniform as applied to each class of vehicle which shall be defined by the director. Except for fees collected by the director pursuant to Section 36-1776, the inspection fee shall be collected with the registration fee by the county assessor at the time and place of motor vehicle registration pursuant to title 28, chapter 3, section 1, and:
>
> 1. The assessor of each county is constituted an agent of the department of transportation for the collection of the emissions inspection fee.
> 2. All monies received from inspection fees by the county assessor shall be immediately transferred by the collecting officer to the state treasurer and by him to the emissions inspection fund.
>
> D. Any person whose vehicle has been inspected at an official emissions inspection station shall, if such vehicle was not found to comply with the minimum standards,

> have his vehicle repaired and have the right within thirty consecutive calendar days but not thereafter to return such vehicles for one reinspection without charge."

Rhode Island's legislation deals with the issue of fees in the following manner:

> "31-38.3 Inspection Fees; Composition and Disposition.
>
> a. The registrar (of Motor Vehicles) shall fix, regulate and alter in accordance with this section, the fees required to be paid for the inspection of every vehicle inspected pursuant to this chapter. Such fees shall be originally fixed and thereafter adjusted by the registrar to reflect the contractual charge payable to any independent contractor as well as any increase or decrease in the costs to the state of providing and administering inspection services.
>
> b. The fees charged for official inspection shall be uniform throughout the state and shall be collected at the point of inspection.
>
> c. Any person whose vehicle has been inspected at an official inspection station, shall, if such vehicle was not found to comply with the minimum standards, have his vehicle repaired and have the right within 20 calendar days, but not thereafter, to return such vehicle for one (1) reinspection without charge."

B.3.14 TIME OF IMPLEMENTATION

A general implementation schedule should be included in the enabling legislation. Some states have implemented their programs in phases, beginning with either a voluntary program, or a mandatory trial program covering a small geographic area. This approach can be instrumental in gauging public response to a program in operation and to discover and correct operational problems in the familiarization phase. It thus presents the opportunity for the public to become familiar with the program before it is expanded to its fullest coverage.

The State of California in Assembly Bill No. 4161 called for such a phased program:

> It is, therefore, the intent and purpose of the legislature, in enacting this program to establish a demonstration program in Los Angeles, Orange, Riverside, San Bernardino, Santa Barbara, and Ventura Counties for the periodic inspection of motor vehicles."

Arizona initiated a one-year mandatory inspection program with no required maintenance as a prelude to its general program. The legislation states:

> "A. Pursuant to ARS 36-1772, all vehicles required by this article to be subjected to the mandatory vehicular emissions inspection shall be required to be inspected, but, from 12:01 a.m. on January 1, 1976 to 12:01 a.m. on January 1, 1977, shall not be required to pass inspection.
>
> B. All vehicles required by this article to be subjected to the mandatory vehicular emissions inspection shall be required to pass the inspections subsequent to 12:01 a.m. on January 1, 1977."

Section 36-1772 of the Arizona Revised Statutes is referred to by this passage. Section 36-1772 established I/M in Arizona. Regarding program commencement it states in Part A of this section that "such inspection shall commence in counties with a population in excess of three hundred fifty thousand by January 1, 1976."

B.3.15 ANNUAL STUDY

Even though administrative monitoring must be an ongoing aspect of any I/M program, it is recommended that a comprehensive study be performed annually. The purpose of the study is to present an update and status report to the legislature concerning the progress made in achieving the intent of the program. It is also to provide grounds for making necessary revision(s) to the I/M legislation, or to make specific corrections to alleviate certain problems.

Some states have addressed this issue by authorizing an existing agency to perform the annual review, whereas others have formed a Commission for this purpose. The State of California in House Bill No. 4161 addresses this issue in the following manner:

> 9889.59: (a) The department shall conduct ongoing cost-benefit analyses and other evaluations of the inspection program, including, but not limited to, observed patterns of malfunctions in inspected motor vehicles' emissions control and quantifications of reductions in vehicular emission in the geographical area subject to the provisions of this chapter, and recommendations for legislation to improve the inspection program. The department shall deliver periodic written reports to the Legislature on such analyses and evaluations at least every 12 months commencing not later than July 1, 1978.
>
> (b) The department shall study and submit recommendations to the Legislature no later than July 1, 1982, on whether the inspection program should be extended and, if so, to what extent to other areas of the state.
>
> (c) The Legislature shall create a joint committee to receive and evaluate the reports and recommendations submitted by the department to the Legislature pursuant to this section. On the basis of such evaluation, the committee shall, from time to time, recommend to the Legislature supplementary legislation it deems advisable to facilitate motor vehicle emissions inspections.

The State of Minnesota is presently drafting I/M legislation. The proposed Minnesota statute makes the following provisions for data collection and studies:

> "Subd. 2. (STUDIES, DATA COLLECTIONS, ANNUAL REPORT.)
>
> The commissioner and the (pollution control) agency shall collect data and undertake studies as are necessary to evaluate the cost, effectiveness, and benefits of the motor vehicle inspection program. The director, the commissioner, the commissioner of transportation and the director of the energy agency or their designees, shall jointly constitute an advisory committee to consider among other issues related to motor vehicles inspection the following:

a. the cost, effectiveness, and benefits of the inspection program;
b. whether vehicles weighing over 8,500 pounds should be included in the inspection program;
c. whether mandatory inspection of motor vehicles should be extended to other areas of the state;
d. the desirability of certification, licensing, or bonding of repair facilities for the protection of the public; and
e. the desirability of allowing official inspection facility personnel to make minor adjustments with the consent of the motor vehicle owner.

> The director of the agency, or his designee, shall be the chairman of the committee. The director and the committee shall seek information from the general public, consumer groups, environmental groups, and the repair and parts industry regarding these matters, and may establish an advisory committee on motor vehicles inspection if it deems advisable. The agency shall report on these matters and the general operation of the motor vehicle inspection program to the legislature on or before January 1, 1982 and each four years thereafter."

B.3.16 TAMPERING

This issue has been identified as critical in most legislation reviewed. States are intent on preventing individuals from physically altering or otherwise thwarting the function of emission control equipment, and on providing penalties for such tampering. Legislation has been drafted in the State of Michigan to prohibit emission control tampering. The proposal, in part, reads as follows:

> Sec. 27. (1) A person shall not remove or render inoperative, or cause to be removed or rendered inoperative, an air cleaning device, or an element of an air cleaning device required to be installed on or in a motor vehicle engine or exhaust system by federal law or regulations. This subsection shall not apply to:
>
> A. The repair or proper replacement of the air cleaning device or an element of the air cleaning device.

B. The installation of another air cleaning device, or element of an air cleaning device, if the device or element is certified by United States Environmental Protection Agency as more effective than the original device or element in reducing the emission of air contaminants into the atmosphere.

C. A motor vehicle which is used exclusively for competition and is not operated on a public street or highway.

(2) A person shall not advertise to remove or render inoperative an air cleaning device, or an element of an air cleaning device required to be installed on or in a motor vehicle engine or exhaust system by federal law or regulation, except for the purpose of replacing the device or element with an air cleaning device or element certified by the United States Environmental Protection Agency as more effective than the original device or element in reducing the emission of air contaminants into the atmosphere.

(3) As used in this section, "motor vehicle" means a vehicle propelled other than by muscular power, except a vehicle which travels only upon rails or a tract.

Section 203 of the Clean Air Act contains similar provisions which basically are reflected in the Michigan proposal. If this legislation is enacted prior to the implementation of an I/M program, a simple statement referring to the tampering legislation might be sufficient. The other option is to include tampering prohibitions explicitly in the I/M legislation, thereby complementing or superseding legislation in effect at that time.

B.3.17 PENALTIES

Provision for penalties is essential to the enforcement of any program. Without suitable penalties for violation, I/M regulations would be ignored, thereby negating the intent of the legislation. The State of Rhode Island in Section 31-38-8 classifies violations of I/M program regulations by severity:

"31-38-8. Penalties.

a. Except as provided in subsection (b) of this section, any person who violates any provision of this chapter or any rule or regulation of the registrar adopted pursuant to this chapter, is guilty of a misdemeanor.

b. Any person who makes or issues any limitation or counterfeit of any official certificate or certificates of inspection is guilty of a felony.

c. Any person who demands or collects a fee for the inspection of a vehicle other than the fee fixed by the registrar for the inspection of vehicles is guilty of a misdemeanor.

In the Minnesota legislation the following penalties are stipulated:

"Section 9. (PENALTIES.) Subdivision 1.

(a) Any employee of an official inspection station or of a fleet inspection station who certifies a motor vehicle as in compliance without having inspected its equipment and mechanisms, or who wilfully certifies a motor vehicle which has equipment and mechanism which do not meet or exceed the criteria and standards therefore, shall be guilty of a misdemeanor."

"(b) Any employee of an official inspection station who undertakes to furnish information to, recommend, suggest, or designate to a motor vehicle owner or operator, or any other person connected therewith, the name or any other description of a parts or repair facility or any other place where parts, repairs, or adjustments may be obtained to being a motor vehicle into conformance with inspection requirements, whall be guilty of a misdemeanor."

"(c) Any person who materially alters or changes any equipment or mechanisms of a motor vehicle that has been certified to comply with standards promulgated under this act, which causes the motor vehicle to be in non-compliance with the standards and criteria, shall be guilty of a misdemeanor."

> "(d) Any person who provides information to an inspection station on the extent or cost of repairs done to bring a motor vehicle into compliance with the standards promulgated under this act, when such repairs were not undertaken or when the cost was not as represented, shall be guilty of a misdemeanor."

B.3.18 WARRANTY

Some states have a special provision for warranty protection in connection with emission equipment and/or repair work performed subsequent to emission testing. Most of the warranty provisions derive from Section 207 of the Clean Air Act of 1977. This section mandates a new vehicle engine emission control warranty, which includes a general defect warranty in 207(a), a performance warranty in 207(b), and an enforcement and recall provision in 207(c).

Some states have included a simple warranty statement in their legislation. For example, Section 7:27 - 15.8 of New Jersey's legislation reads:

> (a) Whenever a motor vehicle is rejected for emissions and if such model vehicle classification is not in compliance with a correlative test as determined by the Administrator of the Environmental Protection Agency, the cost of repair of such vehicle shall be borne by the manufacturer if the owner has complied by the manufacturer's warranty requirements for emission control.

B.3.19 EXCEPTIONS

A tendency of existing I/M legislation is to exclude certain types of vehicles from inspection procedures. These exclusions are based upon the predominant use of certain vehicles in off-road activities (i.e., agricultural implements), on presumed low-use characteristics, or on the difficulty for certain vehicles in meeting emissions inspection standards. A partial list of exception criteria that have been adopted in various states is presented below.

- Vehicle age (Certain states have a "moving" exception; for example, Arizona exempts vehicles more than 13 years old in a given year.)
- Vehicle type (Some states tend to exempt trucks with a gross vehicle weight of 8,500 lbs or more.)
- Junk (hobby) vehicles
- Vehicles for special use on private property, such as golf carts
- Off-road vehicles
- Agricultural vehicles (tractors, trucks with farm plates, etc.)
- Special purpose transit vehicles

Obviously, the more vehicle categories that are exempted from testing, the greater the attention that must be directed to emission standards for test subject vehicles in order that overall emission reduction goals are met.

B.3.20 VARIANCES

Variance is another issue that should be addressed in a section of I/M legislation. If one make or model of a certain year is not capable of repair, retest or meeting established emission levels, a variance could be granted for that particular make/model year vehicle to remain out of compliance, rather than relaxing relevant standards for engine displacement or age on account of that particular vehicle.

The State of New Jersey is considering a regulation to amend its existing I/M legislation. The proposed regulation addresses the issue of variances as follows:

> 7:27-15.10 [15.6] Variances
>
> [(a) Whenever the Director, Division of Motor Vehicles, has reason to believe that any model year of vehicle (or classification of light-duty gasoline-fueled vehicles) up to and including 1967 cannot comply with the emission standards as set forth in Section 15.4, he shall so advise the Commissioner, Department of Environmental Protection, stating the manufacturer, model, year and classification of such vehicles. After consultation with the Commissioner,

Department of Environmental Protection, the Director, Division of Motor Vehicles, may waive any inspection standards for such motor vehicles.]

(a) Whenever the Commissioner has reason to believe that any model year vehicle cannot comply with emission standards set forth in Sections 15.3, 15.4, and 15.5 of this Subchapter, he shall consult with the Director, Division of Motor Vehicles, stating the manufacturer, model year, and classification of such vehicle. The Commissioner, after determining that compliance with emission standards as set forth above is not possible, may waive any emission inspection standard for such vehicle or establish alternative standards for such vehicle. Such waiver or alternative standards may apply to any specific classification deemed necessary, be it by manufacturer, model year, engine displacement, etc.

(b) Whenever the estimated cost of emission compliance for reinspection exceed one hundred dollars ($100) for a vehicle 10 years or older, the owner of such vehicles may apply to the Department for a waiver of compliance presenting the vehicle repair cost estimate from a licensed reinspection center. Such application must include vehicle license, make, year, date, reinspection center and mechanic's name.

B.4 SUPPLEMENTAL ISSUES

If a state is considering implementation of an I/M program through private contractor(s), four additional issues should be addressed in the legislation. These issues are discussed below.

B.4.1 ESTABLISHMENT OF CONTRACT WITH PRIVATE CONTRACTOR

If an emission testing program is to be operated by a private contractor, the state agency directed to administer the program should also be empowered to let bids for a contract for services and to select and enter into contract with the successful bidder. The State of Arizona in Chapter 158 of House Bill 2319 dealt with this question as follows:

> "36-1775. Agreement with independent contractor; qualifications of contractor; agreement provisions.
>
> A. The Director is authorized to enter into an emissions inspection agreement with one or more independent contractors subject to public bidding, to provide for the construction, equipment, establishment, maintenance and operation of an official emissions inspection stations in such numbers and locations as may be required to provide vehicle owners reasonably convenient access to inspection facilities for the purpose of obtaining compliance with this article and the rules and regulations adopted pursuant hereto."

B.4.2 MONITORING OF CONTRACTOR PERFORMANCE

It is imperative that the State retain the authority to observe the activities of the contractor at all times as a quality control mechanism. Contractor monitoring enhances program acceptance by the public in a context in which there is distrust of the auto repair industry and related enterprises, no matter in what capacity.

The State of Arizona provides for contractor monitoring including it in the description of the State's authority and by powers over the private test station operator:

> "...3. The minimum requirements for adequate staff, equipment, management and hours and place of operation of official emissions inspection stations. 4. The submission of such reports and documentation concerning the operation of official emissions inspection stations as the director may require. 5. Surveillance by the Department of Health Services to ensure compliance with vehicular emissions standards, procedures, rules, regulations and laws.
> 6. Any other provision deemed necessary by the Director for the administration of enforcement of the emissions inspection agreement."

B.4.3 CONFLICT OF INTEREST

It is essential for purposes of consumer protection that a contractor operating an I/M program shall not stand to profit by an increase in the number of vehicle failures.

Licensing of Authorized Station Required

The Department of Motor Vehicles shall investigate any applicant for an authorized station license, and before an applicant for an authorized station is approved, an inspection of the premises will be made by an authorized representative of the Department of Motor Vehicles.

No license shall be issued to an applicant unless the applicant employs at least one approved inspector, who may be the station owner.

All inspections must be performed only at the established place of business using an approved exhaust gas infra red analyzer and diagnostic equipment.

The authorized station license and all other licenses issued to approved inspectors shall be displayed in a conspicuous place under glass or other transparent material within the authorized station.

Authorized station shall be required to keep attached to their infra red analyzer manufacturer's quick reference guides for hookup and testing procedures for their infra red equipment.

Application, Fee for Authorized Stations; Issuance of License Certificate

Application for an authorized station license shall be filed upon forms supplied by the Department of Motor Vehicles, and the applicant shall furnish:

Such proof as the Department of Motor Vehicles may deem necessary that the applicant qualifies as an authorized station, including proof that the applicant has an established place of business in this State:

Fee of $25.

License expires at midnight on December 31 of each calendar year.

Upon receipt of such application, when satisfied that the applicant is entitled thereto, the Department of Motor Vehicles shall issue to the applicant an authorized station license certificate containing the station's name and the address of his fixed place of business.

Most states employing a private contractor for vehicle inspections specifically prohibit the contractor from repairing or maintaining failed vehicles. Section 9889.52, Part C of the California legislation notes that "...A private entity operating any portion of the inspection program shall not have any financial interest in any automotive repair station located within the geographical area in which the program is being conducted."

Section 4 of the pending Minnesota legislation decrees that "...The agency shall not contract with any person who is engaged in the business of selling, maintaining, or repairing motor vehicles or selling motor vehicle replacement or repair parts at retail in this state, except that the contractor may repair any motor vehicle owned or operated by the contractor." Subdivision 2 (repairs) states, "The word 'inspection' as used in this section shall not include repairs and adjustments. Repairs or adjustments necessary to bring a motor vehicle into conformance with the criteria and standards under this act shall be the responsibility of the motor vehicle owner and may be made by the owner of any repair facility of his choosing."

B.4.4 LICENSING OF INSPECTION FACILITIES

Some section of I/M legislation should ensure that if private garages are to be utilized as inspection stations, then only those garages having proper equipment and qualified personnel to inspect the vehicles will perform inspections. The State of Nevada, in which the I/M program is based on the existing private garage system, provides an excellent example of appropriate legislative provision for the licensing of inspection facilities.

APPENDIX C

PUBLIC INFORMATION STRATEGIES

APPENDIX C

PUBLIC INFORMATION STRATEGIES

C.1 OVERVIEW

An I/M program, by virtue of its impact on the habits of society, creates a climate in which people may be intensely sensitive to the issues, and which can turn quickly and radically negative if communications between responsible government officials and the general public are poor. I/M procedures to the layman may seem tortuous and protracted; strategies and policies may be framed in terms that are intelligible only to experts. If program implementation is handled clumsily, the government authority may ultimately be perceived as a dehumanized technocracy, indifferent to opinion and unresponsive to protest. Within the context of representative government, I/M is one of those areas in which the need to create and maintain a good relationship with the public is self-evident.

Communications are the essential element in this program; they form the bridge which will act as a framework for participation and allow the exchange of attitudes and ideas between the general public and the government officials. The term "public relations" embraces the set of activities involved in the communication of issues, policies, and operations to a constituency. Publicity is only one facet of these activities, and a great deal of interactive public relations work needs to be done at the grass roots level prior to the implementation of any I/M program. A properly implemented public relations effort prior to instituting an I/M program will facilitate the phase-in of such a program in the State of Michigan.

This section is intended to be a guide for effective public relations toward successful implementation of an I/M program in the State of Michigan. Its purpose is to put public relations in perspective, to explain various public relations techniques, and to show how these can be used in the course of an effective public relations campaign.

Only a framework of activities for the campaign effort is presented, in that a public relations expert could easily expand on the ideas expressed and tailor them to Michigan conditions. Techniques are consistent with and in most cases seek to amplify procedures discussed in EPA's draft Expanded Guidelines on Public Information and Involvement in the Transportation-Air Quality Planning Process (June 1, 1979).

C.2 THE FUNCTION OF PUBLIC INFORMATION

Prior to proceeding with a discussion of the actual public information program, a general description of the function of various elements of a public information program might be appropriate. Figure C-1 represents a typical public information/relations flow chart.

This functional flow chart starts with the media. The term "media" means all forms of communication reaching the public, including radio, television, newspapers, magazines and mail advertising, which influence public perceptions and decisions. "Public" means every individual, organization, or group whose attitudes or opinions can affect the success of a program. It includes the general public, which in this context refers to unorganized and special-interest groups. The effect of the media on the general public depends on two things - the existing attitudes of the public and the nature of the ideas or messages reaching the public.

Progression of a public relations campaign from media effort to action posture is a multi-step procedure as shown in C-1. The ideas or messages reaching the public influence their attitudes and are transformed into opinion, which may be favorable or unfavorable. Public opinion about any organization or program is a key factor in the Integration of the Organization (or Program) with its Environment. Public Information policies are formed from the recommendations made in this step. These recommendations go on to Management, where results depend on the Organizational Characteristics and Intervening Variables. All variables are integral to the decision made by the organization responsible,

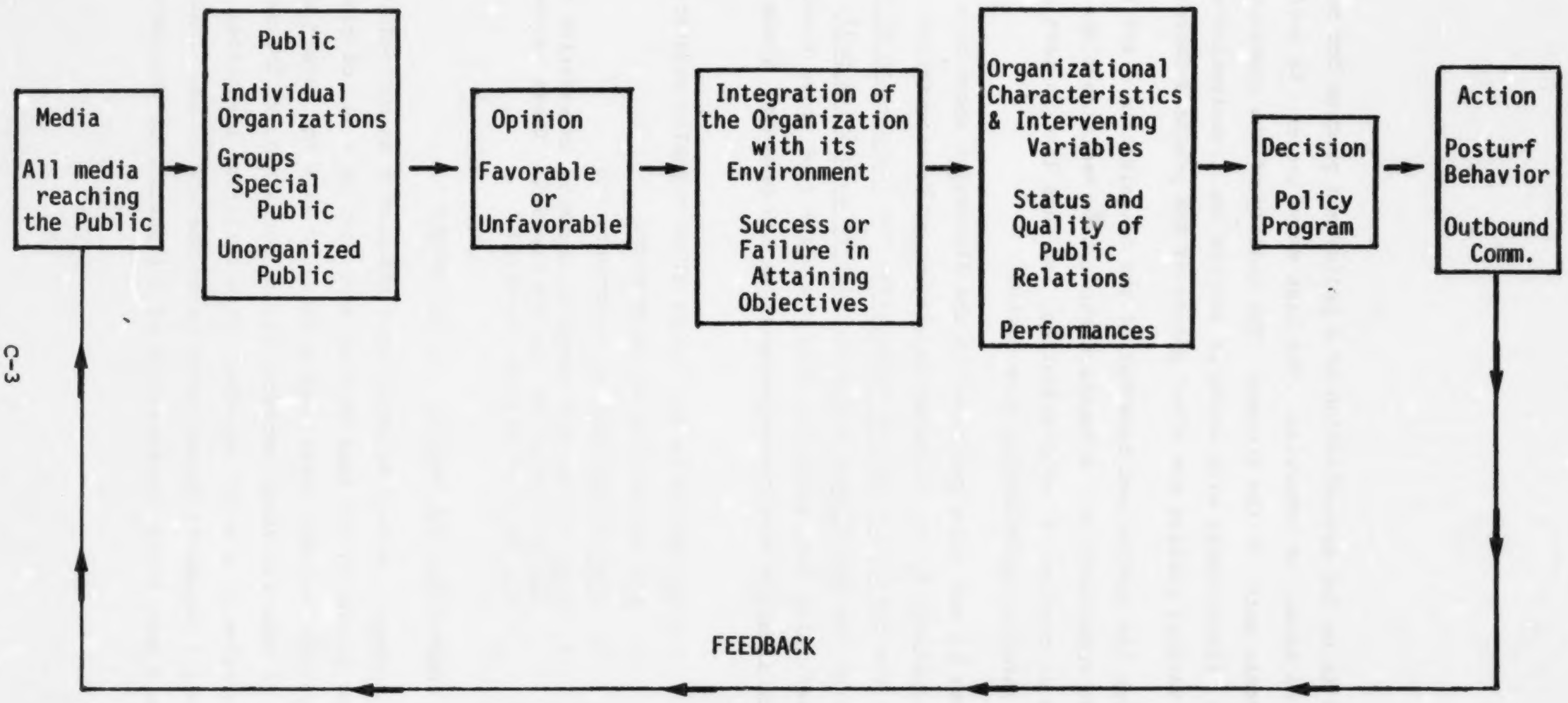
Media
All media reaching the Public
Public
Individual Organizations
Groups Special Public
Unorganized Public
Opinion
Favorable or Unfavorable
Integration of the Organization with its Environment
Success or Failure in Attaining Objectives
Organizational Characteristics & Intervening Variables
Status and Quality of Public Relations
Performances
Decision
Policy Program
Action
Posturf Behavior
Outbound Comm.
FEEDBACK

Figure C-1. The Public Information/Relations Flow Chart whether it be for determination of a policy and program for making decisions known, or otherwise. The last step, Action, is obviously the pivotal point of the process. The quality of the communication and the effectiveness with which it carries the organization's message to the various publics are vital points of the public information function.

From the posture and behavior of the organization - and from its outbound communication - a Feedback through to Media develops. The process is continuous, self-adjusting, and each link is part of this Public Information/Relations Flow System.

Some of the steps mentioned in the discussion above have already been undertaken by the Michigan Department of Transportation. They include the definition of the objectives, the formulation of the central ideas, and the formulation and conduction of an opinion poll. There are essentially four remaining elements which need to be resolved in order to catalyze public acceptance of an I/M program. These decisions concern:

1. Who should be the target(s) of a public relations campaign;
2. How should they be approached;
3. What information is important; and
4. When should this campaign commence in relation to the implementation of the I/M program. These issues are at the focus of discussion below.

C.2.1 IDENTIFYING THE PUBLIC: TARGET GROUPS

A community should be considered not merely an aggregation of citizens living in the same general area, but as a set of groups who share certain values, ideas, and a sense of what the future should be. We are to consider those societal values pertaining to the ownership and operation of a motor vehicle. This criterion identifies a target group - all residents except those under the age of 18. This, of course, targets a very broad cross-section of the public for the campaign.

Any targeted public can be divided into two groups - organized and unorganized. It is easier to identify and direct an approach to the organized group. Unorganized groups may be accessible only through a mass media strategy.

The group that should initially be targeted is the employees of the State of Michigan. This group can be reached at minimal cost, and the propagational benefits deriving from such an informed core of supporters can be substantial. That is, a program of sound internal communication will not only stimulate and maintain employees' interest, but can also make them better public relation representatives to the rest of the community.

Section F.2 of EPA's draft Public Information Guidelines cites identification of and interaction with "affected and interest constituencies of the public" as an essential element of an effective program. Government agencies are encouraged to tap and build upon the contacts and expertise of such groups in a close working relationship. There are many private and public organizations that should be targeted in the public information effort. These groups should be made acquainted with the potential detrimental effects of air pollution on individual health, the part that an effective I/M program can play in the reduction of air pollution, and other expected benefits such as fuel savings and warranty protection. Candidate organizations should include chapters of nationally-oriented groups such as Lung Associations as well as locally-based groups such as individual Chambers of Commerce. Groups that should be involved from the early stages of a public relations program for Michigan are listed below. Early targeting need not, however, be limited to these organizations.

ORGANIZATIONS INVOLVING ELECTED OFFICIALS

Michigan Municipal League
Michigan State Legislature Board
National Association of Counties
(Other Associations of Elected Officials)

PUBLIC INTEREST GROUPS

League of Women Voters of Michigan
Michigan Citizens Lobby
Michigan Health and Safety Institute
American Lung Association
Sierra Club of Michigan
Consumer Protection Organizations

AUTOMOBILE-RELATED GROUPS

Michigan Automobile Dealers Association
Automotive Service Council of Michigan, Inc.
Automobile Club of Michigan
American Academy of Transportation
Michigan Trucking Association

CIVIC GROUPS

Local Chambers of Commerce
Jaycees
Kiwanis
Urban League
NAACP

MEDIA

Local Newspapers
Local Radio Stations
Local Televisions Stations
Radio-Television News Directors Association

LABOR GROUPS

United Auto Workers
AFL-CIO

C.2.2 HOW TO ENLIST HELP FROM GROUPS

The groups identified above could be contacted directly, possibly on an individual basis. It should be recognized that each of these groups is devoted to a relatively specialized purpose, so the campaign might be tailored to the special interest of each. Some of the groups might distribute appropriate I/M literature through regular mailings, while others would invite a guest speaker to a regularly scheduled meeting, presenting the opportunity for direct interpersonal dealings with membership. Whatever the approach, establishment of liaisons and informational exchanges with these groups is probably the most cost-effective strategy with respect to benefits derived (public reached) versus expenditures incurred. Listed below are some additional activities that could be undertaken in the interest-group setting.

- Workshops, seminars, and public meetings arranged through the interest group.
- Where meetings are infeasible, provision of I/M literature through the mail.
- Presentations before public meetings where air quality is a topic of discussion.
- Distribution of materials through trade or organizational publications and newsletters.
- Screening of the American Lung Association/EPA film "On the Road to Clean Air" at various meetings.
- Sponsoring of contests with air quality and I/M in particular as the central theme.

C.2.3 CONVEYING THE MESSAGE TO A BROADER AUDIENCE

Beyond the special group focus, a public relations campaign must succeed in informing a much larger, more amorphous class of citizens, the general public. There are different techniques for this purpose, ranging from newsletters, brochures, direct mailings, and poster displays to the mass media of newspapers, magazines, television, and radio. It is here, particularly in the latter categories, that the greatest expense of mounting a campaign is likely to be borne.

- Newsletters - A newsletter can be a mechanism for regular communication to relatively large audiences. Its purpose is to sustain the interest and involvement of its recipients in the issues it addresses. An I/M newsletter should be mailed on a scheduled basis and cover the status of current I/M prospects and/or programs. For a program already adopted, the newsletter should provide testing locations, their hours of operations, features on the experience of drivers who have had their cars tested, and other relevant material. The most significant cost of producing such a newsletter is not the publishing cost, but the mailing cost. Mailing costs may be minimized by using bulk-rate rather than first-class postage. In general, however, the overall cost does make this a prohibitive alternative for public at large.

- Brochures -Brochures, pamphlets or booklets are an important medium for dissemination of information in states that now have I/M programs in force. The major difference between a newsletter and a brochure is that a newsletter is published on a regular calendar basis, whereas a brochure is a single publication that, if carefully constructed, may be adequate for the life of an I/M program. Preparation of a brochure that intelligibly explains the why and how of an I/M program in Michigan may be a critical milestone in ultimately achieving the goal of enhanced public acceptance. At a minimum, the brochure should present the purpose of the selected I/M program, its benefits, the locations of testing facilities, hours of operation, an explanation of quality assurance mechanisms, and a section in question/answer format addressing known or anticipated public concerns. The responsible organization might consider updating the brochure at yearly intervals, or even more frequently.

The methods of disseminating these brochures range from inclusion with mailed notification to vehicle owners of the annual vehicle registration requirement, to open distribution at shopping centers, gasoline stations, repair garages and other locations frequented by the driving public. These methods tend to keep distribution costs low.

- Mass Media. - Mass media probably provide the best mechanism for reaching the braodest possible segment of the public. Mass media include newspapers, wire services, television, radio, trade journals and magazines. There are several techniques for deploying these tools to obtain favorable publicity.

  - General News Release - This is the basic, and perhaps the most widely used, method of obtaining publicity. News releases should be delivered to editors of local papers well ahead of the time desired for their presentation to the public. Any release should include a newsworthy item which justifies it. This may be a compendium of new test or study results, official statements, views or other material which could be used in the formulation of a feature story should an editor so desire.

  - News Conference - The news conference has become a very popular technique for the dissemination of official views and public information. The appearance of state officials, such as legislators or the Governor, in a context supportive of I/M program generates favorable publicity. Experience in other states has indicated that pictorial coverage of a high public official (e.g., Governor Milliken) in the process of having his car inspected is an inestimably important selling point for I/M. Publicized debate or seminars also attract needed attention.

  - Featured Article - A feature article covers a subject much more thoroughly than a straight news announcement. The interest of a feature writer in the topic of I/M may be whetted by providing him or her with frequent notices about programs and prospects. To follow up, the writer would seek additional information for his article, thus assuming the burden of in-depth evaluation. More pointedly, if a writer is on record as expressing a particular interest in environmental issues, then he or she might be encouraged to devote favorable articles to the I/M issue.

The broadcast media should be utilized differently from the print media. News releases and conferences and even general news broadcasts are limited with respect to the audience reached. Fortunately, Federal Communications Commission (FCC) regulations provide automatic access to a large, random cross-section of the public. The FCC requires radio and television stations to make commercial time available for public service announcements. This free time should be used to as great an extent as possible. Spot announcement slots are usually available in 10, 20, or 30 second increments. The EPA has prepared several public service announcements covering I/M and ozone-health effects topics which fit these slots and which may be obtained free of charge through regional offices. Unfortunately, due to the large demand for public service announcement time, the number of I/M announcements that could be presented is limited. Moreover, public service announcements are often presented at marginal viewing hours (between midnight and 7 a.m.). Because the scheduling of these announcements is at the discretion of each station, not much can be done about this. It has been suggested, however, that stations tend to broadcast those announcements which are interesting and eye-catching more frequently, often in prime time.

- Direct Advertisement - All of the publicity measures mentioned previously are competing with perhaps hundreds of other publicity items which are considered to be important by their sponsors. With the proliferation of these announcements, the I/M message is often lost. Therefore, in order to carry out a complete public information program, advertising space in newspapers and commercial slots on television and radio must be purchased.

Table C-1 presents the estimated cost or resource requirements of various advertising media. The figures are based on national averages.

Table C-1. INITIAL/ONGOING PUBLIC INFORMATION PROGRAM FOR ONE YEAR HYPOTHETICAL LOCATION

PROGRAM TYPE	COST DESCRIPTION
ADVERTISEMENTS	
1. Public Service Announcements	
Newspaper	Full page advertisement 172-inch @ 1.65 per inch.
Television	1-minute announcements @ $40 per per 10-second or $240 per minute.
Radio	1-minute announcements @ $200 per minute (includes radio and commission).
2. Pamphlet	
Development/preparation	Artist (logo and cover design) plus commission @ 20 hours.
Printing	Pamphlet printed on 20 lb paper, 1 color, foldout 7½" x 11" 6 million copies).
3. Bumper Sticker	Printed on 6 lb all weather paper, 1 color. $60,000/4.5 mil. veh.
4. Transit Aids	Space cost on 35 buses, $102 per month per bus (both sides).

C.3 OVERALL PROGRAM COSTS

The cost of a public information program is largely a function of its location and breadth of coverage. Hamilton Test Systems, Inc., under contract to the State of Arizona, considers $0.12 per vehicle as an adequate investment for an effective public information program. This figure includes the initial and ongoing cost of production and distribution of brochures, radio spot announcements, and news coverage. However, this allocation may be low for 1979, because the publicity effort on which it was based was completed several years ago, and the ongoing Arizona effort is minimal. Therefore, computations have been utilizing alternative figures. These figures are presented in Table C-2. For the purpose of this study, costing of the public information effort assumes a value of $0.25 per vehicle (last row of the table).

For an example funding mechanism, one might again cite the State of Arizona, which has included provision for the public information program cost in its testing fee structure and has thereby recovered these costs automatically. The State of Michigan might consider a similar mechanism. To supplement, Section F.7 of the draft EPA Public Information Guidelines recommends the allocation of 20 to 30 percent of funds authorized under Section 175 of the Clean Air Act as Amended to organizations directly responsible for promulgation of public awareness in nonattainment areas. The total amount of these funds will vary as a function of nonattainment area population and severity of the air pollution problem.

These public information costs are not total costs and should be apportioned among selected available publicity measures in order to gain the maximum exposure for the money expended. Table C-3 suggests a possible breakdown of the public information budget. This breakdown was arrived at after consulting various advertising agencies. However, the local situation should be taken into consideration when deciding to allocate resources among various media. For example, if an area does not have a local television station, but is instead served by radio and newspaper, then television's share might be split between

Table C-2. COSTS OF PUBLIC INFORMATION PROGRAM
UNDER VARYING PER-VEHICLE ALLOCATIONS

	AREA OF COVERAGE					
Cost per Vehicle (dollars)	DETROIT	FLINT	LANSING	GRAND RAPIDS	NON-ATTAINMENT COUNTIES	STATEWIDE
0.12	330,428.40	33,049.60	267,408.00	42,841.20	598,556.40	656,404.80
0.15	413,035.50	40,062.00	334,260.00	53,551.50	748,195.50	820,506.00
0.20	550,714.00	53,416.00	445,680.00	71,402.00	997,594.00	1,094,008.00
0.25	688,392.50	66,770.00	557,100.00	89,652.50	1,246,992.50	1,367,510.00

Table C-3. PUBLIC INFORMATION RESOURCE ALLOCATION

TYPE	PERCENT SPLIT
Presentation Film Slide Show Guest Speaker	 ($30,000) ($ 2,000) ---
Newspaper	23
Television	21
Radio	28
Pamphlet	10
Bumper Sticker	5
Transit Ads	8
Other	3-5

Table C-4. VARIOUS ALLOCATIONS VS POSSIBLE METHOD OF ADVERTISEMENT IN THE DETROIT AREA

$ per vehicle Method of Public Relations	0.12	0.15	0.20	0.25
PRESENTATION				
Film	30,000	30,000	30,000	30,000
Slide	2,000	2,000	2,000	2,000
Guest	--	--	--	--
NEWSPAPER	68,640	87,640	119,300	150,970
TELEVISION	62,670	80,010	108,930	137,840
RADIO	83,560	10,670	145,240	183,790
PAMPHLET	29,840	38,100	51,870	65,640
BUMPER STICKER	14,920	19,050	25,935	32,820
TRANSIT ADS	23,870	30,480	41,500	52,510
OTHER	8,950	11,430	15,560	19,690

these two available outlets. Table C-4 presents an example budget for the Detroit nonattainment area based on the figures from Tables C-2 and C-3. The same rules would apply to budget computations from the other nonattainment areas.

C-4 IMPLEMENTATION SCHEDULE

In order to maximize the likelihood of positive public acceptance of an I/M program, a public information campaign should be phased in systematically over a period of time. Failure to allow for appropriate phasing may render the entire public relations outlay futile. A public relations program commenced prematurely can exhaust available resources early, rendering pursuit of the campaign impossible at its most critical period - that of I/M implementation. Conversely, a program commenced at an advanced date of I/M development might not be able to neutralize the suspicions or hostilities of the general public to an extent sufficient to make I/M politically tractable.

Based on discussions with professional publicists and with officials in the State of Arizona, a public information timetable has been completed for Michigan. This timetable is presented in Figure C-2. This timetable pertains only to the official preimplementation campaign conducted pursuant to obtaining necessary I/M enabling legislation. It should be noted that the State of Michigan has instituted and will continue to pursue an active public awareness effort prior to legislative adoption of I/M, for the purpose of communicating to the citizens of the State just what I/M is, why it is needed, and what will be its trade-offs. This effort is undertaken jointly with public and special interest groups statewide. Because the effort is wholly within the context of established structures and budgeting arrangements, no special costs are assigned.

In general, it is recommended that the preimplementation information campaign be initiated 12 months prior to the actual implementation of the I/M program. Campaign activity should be most intense

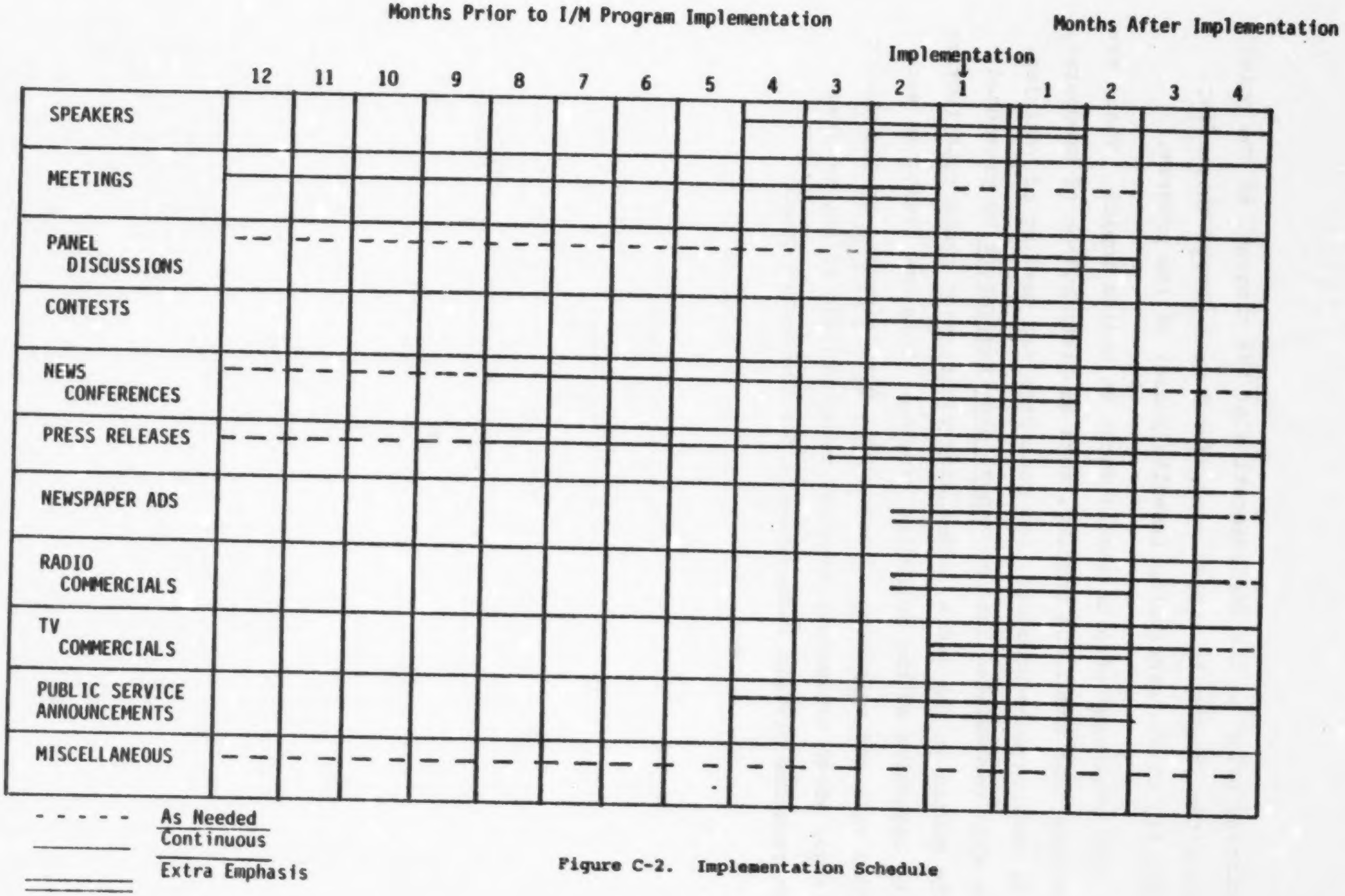

Figure C-2. Implementation Schedule

immediately prior to the implementation of the program, at the point at which the program is implemented, for 2 or 3 months thereafter, and finally at the conclusion (results phase) of the program.

Most publicity efforts should focus on health topics. There are activities that should be ongoing, such as distribution of brochures, public service announcements, and reminders for testing of vehicles. It is also recommended that an annual progress report be presented to the public in the media, commending citizens on their contribution to the reduction of the pollution problem. This can create an aura of good will and a feeling of meaningful participation by the public at large, which ultimately enhances receptiveness to any program which requires private inconvenience for the common good.

APPENDIX D

MECHANICS TRAINING FOR VALID REPAIR

APPENDIX D

MECHANICS TRAINING FOR VALID REPAIR

D.1 OVERVIEW

The quality of repairs is the major factor contributing to the success of a vehicular emissions I/M program. An adequate number of trained mechanics is necessary in order to properly repair vehicles that fail the emissions inspection.

The complexity of emissions control systems has been increasing almost annually, resulting in a severe burden on mechanics in the field, who must constantly update their knowledge of new systems and techniques of repair. However, regular enhancement of mechanics' knowledge of emission control systems has not generally been the case. The result of this shortfall of knowledge is substandard repair on the motor vehicles, which in turn results in widespread public dissatisfaction with and often mistrust of the repair industry.

Public dissatisfaction may be expected to grow when an I/M program is implemented, and some vehicle owners find that they must have their cars or trucks retested two or three times due to the inferior quality of work being performed by some mechanics. In order to avoid general public unrest and to improve the quality of emission system repair, a mechanics training program should be considered by the State of Michigan.

D.2 EXISTING CONDITIONS

The State of Michigan has empowered into law Act No. 300 of the Public Acts of 1974, generally known as the "Motor Vehicle Service and Repair Act." This act was passed for the purpose of regulating the motor vehicle repair and service industry. The Act requires each repair facility to have at least one specialty or master mechanic in its employ who is certified in each category of repair that the facility provides until December 31, 1980. Thereafter, all mechanics doing major repair work must be certified. Persons wishing to become certified may obtain a mechanic trainee permit and perform major repairs under the direct supervision of a master mechanic.

One of the repair categories is vehicle tune-up, which in most cases includes general emissions-related work such as carburetor adjustment, PCV valve replacement, charcoal canister replacement and so forth. However, some aspects of tune-up have been classified as minor repairs which need not be performed by a specialty or master mechanic. Some of the emission-related components that are classified as minor repair items include:

- Air cleaner element
- Air pump belt
- Air pump hose
- Fuel filter element
- Fuel filter and associated lines and hoses
- Crankcase closed vent valve
- Crankcase vent air cleaner
- Crankcase vent air cleaner hose
- Exhaust pipe and associated attaching parts
- Vapor canister hose

Section 12 of the Act requires an applicant to have passed an examination designed to test competency in the specific category for which the applicant is applying. Section 13 of the Act provides for mechanic trainees. This section requires the administrator to ...."Establish and operate a mechanic trainee training program designed to provide the training necessary to become certified under this Act. Instead of establishing and operating the program, the administrator may appoint schools, academies, or other similar establishments to engage in mechanic trainee training if those establishments, schools, or academies meet the criteria established by the administrator, after consultation with the Department of Education and the United States Department of Labor, Bureau of Apprenticeship and Training. The establishments may be designated by the administrator to engage in a continuing education and training program for specialty and master mechanics."

It is apparent from the review of existing legislation that the State of Michigan has provided for certain aspects of a mechanic training program. Although the legislation was written to cover motor vehicle repairs as a whole, more emphasis will probably be needed on the emission-related equipment.

D.3 METHODS OF MECHANIC TRAINING

Various approaches have been utilized by different states with I/M in effect toward instituting a mechanics training program. These efforts have ranged from a government-sponsored mechanics training program in the State of Arizona to no program at all in the City of Chicago. The State of Arizona is considered the pioneer in implementation and coordination of mechanics training for emission control repair. Some of the methods suggested below have been utilized by Arizona, whereas others are in use or have been proposed for other areas.

- Workshops - These workshops should involve vocational education instructors, and be carried out several months prior to the implementation of the I/M program. Topical coverage should include the diagnosis and repair of emission control equipment. The desired effect of such a program is that knowledge of proper repair procedures "pyramids" downward from workshop participants to trainees in the vocational education classes they conduct.

- Training Clinics - The intention of training clinics is to inform both mechanics and the general public. It has been the experience that these clinics are in greatest demand during the early stages of the program. The clinics should be about 4 to 5 hours in length and should present both the theoretical aspects of repair and the opportunity for actual "hands-on" experience.

- Mini-schools - The "mini-school" concept is very similar to that of the training clinics, with the exception that the mini-school program would be taken directly to the practising mechanic in the field. That is, sessions are conducted in larger private repair facilities with the cooperation of employers. This method provides the greatest possible access to the state-of-the-art methods and maximum participation opportunity for the practicing mechanic without making an exceptional demand on his or her time.

- Fleet Mechanic Training and Certification Program - This program should be designed to qualify fleet mechanics for emission repair. These mechanics would be licensed to perform maintenance on vehicles in private or public fleets. Arizona designed a program which takes two days and which requires a passing grade on an examination at the conclusion of the course. Once licensed, the fleet mechanic is annually required to attend a half-day refresher course and to pass a recertification test.
- Vocational Course - Auto mechanics courses are regularly offered in the public schools and are usually taken by students seeking basic maintenance and repair skills. Material relating to emission control equipment should be emphasized in order that new mechanics entering the field will have appropriate background sufficient to enable the repair industry to handle the increased demand due to I/M.

An additional source of mechanics training, the automobile industry itself,has not been included in this discussion because it has traditionally provided advanced training courses to certify its own repair personnel. However, it should be noted that the automotive industry has recently begun to play a very active role in training its mechanics for emission repair in programs that include updated bulletins and schools.

D.4 APPROACH TO MECHANICS TRAINING

A comprehensive approach is projected for the mechanics training program in the State of Michigan. A two-phase program has been proposed by state officials. The first phase will be devoted to the need for identification and the training of the instructors, while the second phase will be devoted entirely to the actual training of mechanics.

The rationale for this recommended two-phase program is the fact that a great deal of information on emission control systems currently resides with automobile manufacturers and dealers and service station personnel; however, much of this information is so fragmented or unsystematically organized that the appropriate use cannot be made of it. Furthermore, classes for emission control systems are currently offered at community, state and private colleges, technical schools, and even in the high schools of Michigan. The result is redundancy or even competition among schools in a given geographic area. Due to these and other problems, it was deemed necessary to determine the actual locations where emission control systems are presently taught, the comprehensiveness of instruction, and the extent of practical knowledge gained that is translated into improved quality of service provided by participating mechanics. It would also be necessary to determine whether a given training course emphasizes theory or practical experience.

At the conclusion of this state-of-the-art survey, a format would be developed along with the materials and teaching methods for an instructor's course. A possibility exists that the materials presently used might be reassembled into a format suitable to transmit to a teacher of emission control courses, thereby saving course development costs.

The last task of Phase I would place emphasis on upgrading the knowledge of the instructors themselves. One or more training sessions for instructors could be taught by Michigan personnel or by Colorado State University staff, who have had considerable experience in this field. The cost for these training sessions could be defrayed in either of two ways. The first, obviously, is to charge the instructors a fee for attendance. However, in order to encourage participation, the second alternative is that courses would be provided free of charge to participants with EPA, local MPOs,or the state itself funding the program. Provisions would have to be made for refresher (update) classes or bulletins to keep instructors at the state-of-the-art technical levels after the initial training course.

The second phase of this program would be directed toward training of mechanics in the vocational and technical schools, community and other colleges in those areas of Michigan in which an I/M program will be implemented. This would be done either through a series of state-sponsored workshops or clinics, or through an intensive effort to encourage vocational schools and community colleges to offer courses on automobile emission control. The approach utilized in these courses should familiarize the mechanics with emission control systems in a generic sense rather than on an individual basis. However, materials should be provided to mechanics indicating the specifications and operation of the emission systems for individual makes and models. Once the effort to train the mechanics employed in the field is completed, emission control systems should be integrated into the regular mechanic training curriculum, thereby teaching new mechanics the field.

D.5 MATERIAL COVERED BY MECHANICS TRAINING

Each method of mechanics training should emphasize material tailored to the background and interest of the specific audience. However, at the completion of the training session, each of the participants should be able to accomplish the tasks and to possess the knowledge listed below. These are recommended minimum automotive mechanics standards of the American Association of Motor Vehicle Administrators.

Tasks to be Performed

Diagnose--malfunctions

A. Fuel pump
B. Emission system
C. Analyze combustion
D. Carburetor--repair and/or replace
E. Fuel storage tank
F. Indicator gauge
G. Fuel pump
H. Air filter
I. Carburetor
J. Heat riser valve
K. Exhaust manifold
L. Intake manifold
M. Resonator

Knowledge--Information

1. Safety factors
2. Type and characteristics of fuels
3. Types and use of filters
4. Principles of design, construction, operation and their relationship to component parts
5. Type and use of testing instruments
6. Diesel engine principles
7. Use of manufacturers' service manuals
8. Use of special tools and equipment
9. Types and uses of lines and fittings
10. Use of heating and welding equipment

D.6 COST OF MECHANICS TRAINING

It is difficult to estimate the total cost of mechanics training at this point in the study. A generalization could be made on the costs. It is assumed that whatever the cost of mechanics training, the State of Michigan will fund the program in its early stages; in later stages, the program could be made self-sufficient through reimbursement from mechanics.

There are basically two types of program costs involved. The first type is the initial outlay, considered a one-time cost. The second type is the recurrent cost elements. These are incurred with every scheduled class.

One-time costs include the costs to develop the training curriculum. Colorado State University has produced an extensive array of materials on this subject which could be utilized for developing curriculum. Curriculum costs vary by the comprehensiveness or theme of material. A list of the material and the associated costs is included as Appendix D-II in this section. In general, it has been estimated that one-time costs of $3,500.00 would be incurred for curriculum development.[1]

The second type of costs would essentially consist of materials costs plus salary for instructors and clerical assistants. In the cost estimate, it is assumed that a rental charge would be incurred at the location where the classes will be held. In the event the classes are held at community colleges, high schools or other public facilities, the rental charge would be zero. This would reduce the total program cost.

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[1] Estimate prepared by SCI, Inc.

The cost of a mechanics training program is calculated under the following assumptions:

- There are 20 students per class, except where instructors are students, in which case the number of students per class is 12.
- Instructors' salaries are computed at the base rate of $6.80/hr except where instructors are pupils (Phase I), in which case a rate of $9.00/hr is used.
- Rent (including utilities) is calculated at the rate of $7.50/sq ft per year.
- One set of tools at a cost of $1,000 each is assigned to each instructor.
- There are 17,579 tune-up mechanics targeted for training. (Source: MDOT officials)
- 100 percent participation by mechanics is presumed.
- The ratio of instructors to pupils is assumed to be five percent.
- Twenty hours of classroom training is presumed for mechanics and 40 hours for instructors.

Table D-1. ESTIMATED INSTRUCTION COST (1978 dollars)

	PROGRAM PHASE		
EXPENDITURE ITEMS	PHASE I	PHASE II	TOTAL
Instructors	$26,280	$127,296	$153,576
Rent	6,750	42,189	48,939
Curriculum Development	3,500	0	3,500
Handouts	14,600	71,021	85,621
Audio-Visual	600	2,700	3,300
Tools	2,000	9,000	11,000
	53,730	252,206	305,936
No. of Students	879	17,579	18,458
Cost per Student	$61.13	$14.35	$16.57

D.7 CERTIFICATION OF MECHANICS

Consideration of emission control systems is part of the overall tune-up phase of automobile maintenance. Emission control systems cannot be assigned to a specific or traditional repair category such as brakes or front-end alignment.

An adequate tune-up of post-1968 vehicles requires knowledge of emission control components. Knowledge of these recent engines in their entirety is necessary for a mechanic to possess an understanding of the purpose and function of emission control components sufficient to diagnose, adjust and repair failures. This interdependence prompts the following recommendations.

It is recommended that no new repair category be added to the present mechanics certification program. This would make amendments to the present mechanics' registration act unnecessary. The present mechanic certification tests for tune-up and master mechanics categories should be modified to include questions on emission control systems. With the onset of a mechanics training program for I/M, only mechanics holding current certification as master or tune-up specialists will be eligible for training as emission control mechanics. Following the initial phase-in period, mechanics applying for certification as tune-up or master mechanics will be eligible for emission control training prior to testing. The classification of emission control systems under the tune-up category would enhance quality control by minimizing the chance of a "front end alignment" mechanic performing emission-related repairs.

D.8 IMPLEMENTATION SCHEDULE

A recommended implementation schedule for the mechanics training program is presented in Figure D-1. This schedule is based on the assumption of an I/M program start-up date of January 1, 1983. In the event this start-up date is either advanced or delayed, the entire mechanic training program should be rescheduled correspondingly.

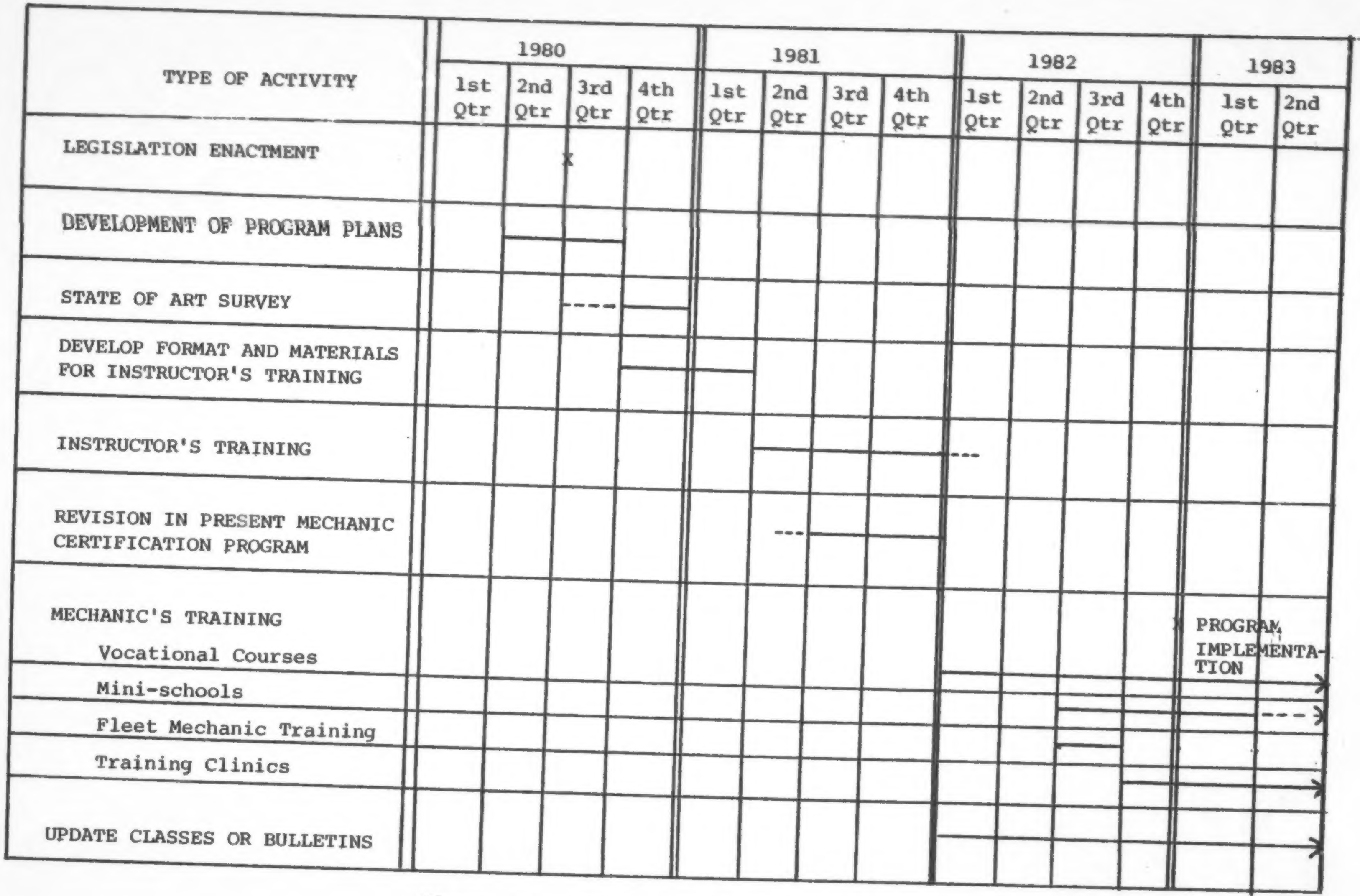

Figure D-1. Recommended Implementation Schedule

APPENDIX D-II

Materials Developed at the Center for Motor Vehicle Emissions Control and Safety

Available Through the Department of Industrial Sciences,
Colorado State University, Fort Collins, Colorado 80523

	Reference Number	Cost
Motor Vehicle Emissions Control Instructional Materials Packet Designed as a complete multimedia training course which includes: Technical related narrative, 35mm slides and audio cassette tapes, test questions with answers and laboratory exercises with tool list. This instructional packet is designed for vocational automotive teachers who wish to train future mechanics, mechanics in the field and additional teachers on the basic concepts of emissions and vehicle emissions control systems.	1122-0	$290.00
Instructor's Guide for use with Vehicle Emissions Control Instructional Materials Packet Designed to aid the instructor in class preparation, demonstrations, "hands on" sessions and the presentation of the "Colorado Emissions Control Packet" (0331-1) and/or the "Motor Vehicle Emissions Control Packet" (1122-0). It consists of key points for improving classroom presentation, suggestions for dramatic "table top" and "live vehicle" demonstrations as well as class formation, time budgeting and effective use of components for demonstration purposes.	0331-3	12.00
Emissions Control Multi-Media Kit Designed as a complete multi-media auto mechanics training course. This Kit includes 359 slides (35 mm); 8 audio cassettes; test questions with answer key and laboratory exercises (including tool list) plus a complete easy to follow instructor's guide. This kit has been designed primarily to be used in the teacher training workshops but is available as an excellent instructional aid for teachers with some background in emissions control instruction. The kit includes 1122-0 and 0331-3.	1122-1	300.00
Chemistry of the Internal Combustion Engine - Running Time (41 min.) A 3/4 inch color video presentation on fuel composition and changes resulting from the combustion process.	1122-2	75.00

	Reference Number	Cost
Motor Vehicle Emissions Control - Series of Seven Books A series of seven illustrated self-instructional books (391 total pages) designed to teach the concepts of emissions control systems. The seven topics covered are: Positive Crankcase Ventilation Systems; Thermostatic Air Cleaner Systems; Air Injection Reaction Systems; Fuel Evaporation Control Systems; Exhaust Gas Recirculation Systems; Spark Control Systems; and Catalytic Converter Systems. Allow one kit for each student since it is a consumable workbook.	1159-1	$20.00
Emissions Control Training Mechanics Handouts Designed to be used in conjunction with the "Motor Vehicle Emissions Control Instructional Materials Packet" (1122-0). The booklet contains handouts, laboratory exercise worksheets and other related information. It is intended for mechanic use while attending an instructor facilitated workshop. It is not designed for use alone, or as a self-instructional device or textbook.	1167-1	4.00
A Primer On Auto Emissions Systems for Home Mechanics A book designed to acquaint the vehicle owner who likes to maintain his automobile with the basic emissions control systems and components installed on today's cars. It contains animated, easy to understand, step by step procedures for checking various components related to emissions control systems. This book is not intended to be a substitute for, or replace a good emissions control service manual.	1167-2	6.00
Instructor's Guide for Vehicle Emissions Control Training A self-contained curriculum with narrative, illustrations and overhead transparency masters. It is designed for instructors with limited background and equipment, who want to teach the basic concepts and key points of vehicle emissions control systems. This guide is part of a training package consisting of "Instructor's Guide" (1167-3) "transparency Masters" (1167-4) and "Student Workbook" (1167-5) designed to be used together.	1167-3	8.00
Transparency Masters for use with Instructor's Guide for Vehicle Emissions Control This training aid provides all the transparency masters which are identified in the Instructor's Guide.	1167-4	6.00

	Reference Number	Cost
Student's Workbook for Vehicle Emissions Control Training A workbook designed to lead students through key points of vehicle emissions control concepts. This workbook parallels the presentation given in the "Instructor's Guide" (1167-3) and requires the student's participation by responding to questions and key points and by performing simplified "hands on" exercises.	1167-5	$6.00
Teacher Classroom Kit A self-contained curriculum complete with all materials and instructions necessary for instructors with limited background and equipment to teach the basic concepts and key points of vehicle emissions control systems. The kit includes 102 page instructor's guide, 116 transparency masters and 1 copy of the student workbook (99 pages). All teaching aids employ a low verbal-pictorial approach. The kit includes 1167-3, 1167-4 and 1167-5.	1167-9	20.00
Electronic Ignition Systems An introductory level approach to electronic ignition theory and operation with comparisons to conventional systems. It is designed to be incorporated into the "Motor Vehicle Emissions Control Instructional Materials Packet" (1122-0). The media used is an audio cassette tape, slides, narrative, test questions and answers.	1167-6	70.00
Colorado Vehicle Emissions Control Mechanic Workbook Designed to be used by the student in conjunction with the "Colorado Emissions Control Packet" (0331-1) and/or the "Motor Vehicle Emissions Control Instructional Materials Packet" (1122-0). Each segment of this student workbook contains emissions concepts, laboratory exercises, self-check questions and related information. It is not designed for use alone, or as a self-instructional device or textbook.	0331-2	4.00
Introduction for Vehicle Emissions Control Two 3/4 inch color video cassettes of an animated introduction to emissions control systems. There are eight (8) presentations with an approximate running time of 10 minutes each. The tapes were produced from the booklet, A Primer On Auto Emissions Systems for Home Mechanics.	0331-4	200.00

	Reference Number	Cost
Inspector's Guide for Vehicle Emissions Control	1167-7	$7.00

An illustrated book to provide the emissions control inspector with basic information needed to understand the various aspects of inspection/maintenance programs, concepts of the various emissions control systems, cause and effect of vehicle emissions and a basic understanding of how the infrared analyzer is used to determine exhaust emissions levels.

Fuel Injection Systems	1191-1	75.00

An introduction to fuel injection systems. Material covered includes theory, electronic and mechanical fuel injection systems and their respective components. It is designed to be incorporated into the "Motor Vehicle Emissions Control Instructional Materials Packet" (1122-0). The media used is an audio cassette tape, slides, narrative, test questions and answers.

APPENDIX E

CONSUMER PROTECTION AND QUALITY ASSURANCE

APPENDIX E

CONSUMER PROTECTION AND QUALITY ASSURANCE

E.1 OVERVIEW

Effective consumer protection and quality assurance elements are important to the success of any I/M program. Consumer protection not only protects the public from unnecessary costs and inconveniences during emission system checkup and repair, but also helps to eliminate inequities caused by drivers who should have their vehicles repaired but avoid doing so by successfully circumventing the intent of vehicle inspection. A quality assurance program results in maintaining uniformity and a high degree of precision in emission testing. The successful implementation of both elements could secure public acceptance of I/M, thereby avoiding build-up of adverse publicity.

There are mechanisms to ensure compliance with a two-faceted consumer protection element. In order to minimize unnecessary costs and inconveniences to the public, technical and administrative safeguards built into post-inspection failure diagnosis facilities and repair garages could best serve the purpose. Examples of specific procedures include consumer hotlines, complaint investigators, repair cost ceilings, and approval and/or certification of repair shops. Some of these elements have been included as program costs in Section 5.0. In the event of a motorist trying to circumvent the inspection system, safeguards should be in place so the likelihood of cheating the system is minimized. Mechanisms to thwart the invalidation of emission inspections by motorists include dummy tailpipe checks and non-tamperable carburetors.

The element of quality assurance addresses the reliability of the actual emission tests as well as the collection and analysis of inspection information. It involves instituting periodic and/or daily equipment checks and performing preventive maintenance, but also includes proper selection of analysis equipment at the outset of the program. The mechanisms dealing with consumer protection and quality assurance are discussed in detail in this appendix.

E.2 EXISTING CONSUMER PROTECTION MECHANISMS IN MICHIGAN

Act No. 300 of the Public Acts of 1974 sets conditions on the practice of servicing and repairing motor vehicles. It proscribes unfair and deceptive practices and provides for enforcement and penalties. Section 257.1309 of the Act in part directs the administrator to "....establish procedures for receiving complaints relating to alleged violations of the act or rules promulgated pursuant to the act." Accordingly, the Department of State, Bureau of Automotive Regulations, has published general rules in regard to vehicle repairs. The general rules set up requirements for repair facilities to post their registration certificate, to provide written estimates for repairs over $20.00, invoices of all labor and parts, and to provide the toll-free phone number of the agency responsible for consumer protection. This toll-free number is accessible from anywhere in the state. The Prosecuting Attorney's office handles consumer protection cases on the county level. If a consumer is dissatisfied with a product or service and feels that he/she has been the victim of unscrupulous business dealings, a complaint can be filed with the "Office of Consumer and Business Affairs" (or comparable office) of the Prosecuting Attorney's office. Even though the Prosecuting Attorney's office is expected to handle complaints on the county level, the majority of complaints are currently processed by the Bureau of Automotive Regulations because its toll-free number has made that office more accessible.

E.3 CONSUMER PROTECTION AS A FUNCTION OF ADMINISTRATIVE MODE

Consumer protection needs vary depending on the program's administrative approach--state-operated, contractor-operated, or private garage. In general, the consumer protection element is similar for the state and the contractor-operated centralized program, with the exception that the State would retain authority for supervision over the contractor's facilities and its operation. Therefore, consumer protection is discussed as a function of centralized or decentralized facilities.

As stated previously, one function of consumer protection is to protect the consumer from receiving inaccurate test results. In this context, a centralized inspection approach provides the best protection to the consumer. Centralized facilities permit the use of standardized testing and calibration procedures using professionally trained personnel. By contrast, in a decentralized program the chances of inaccurate tests are greater due to the difficulty in achieving uniform testing and calibration procedures.

E.3.1 CONSUMER PROTECTION ASPECTS OF A CENTRALIZED PROGRAM

A centralized inspection program has several advantages in providing a consumer accurate and consistent test results. In a centralized program, the vehicles are tested by an independent organization which has no interest in auto repairs. Tests are conducted in high volume facilities utilizing standardized testing procedures in conjunction with specially trained personnel and automated equipment. Testing is the only function performed by these facilities. In the event of failure, an owner has the option to undergo vehicle repair at the garage or service center of his choice, prior to returning his/her vehicle for retest. This retest provides verification of proper vehicle repair to the motorist. Additionally, dependent upon the type of equipment and the mode of calibration, hourly instrument calibration could be instituted along with daily checks, thereby assuring accurate results. Calibration checks are further discussed in a later section. Since the number of testing facilities is limited, personnel and equipment performance can be more closely monitored. In the event of improper testing procedures, an employee could be retrained to correct his/her deficiencies. A centralized program can also eliminate the recording error for test results if the process is fully automated.

In a state-operated centralized program, it is presumed that hourly and daily calibration of equipment would be sufficient to assure proper operation and accurate test results. However, in a contractor-operated program, it is suggested that additional measures be implemented not only to guarantee the accurate testing of vehicles (ensuring that the contractor is complying with the contract), but also to gain public acceptance of the program. There are two methods for developing a verification regimen for emissions testing as an aspect of consumer protection. These two methods,(1) referee stations, and (2) correlation car, are discussed below.

E.3.1.1 Referee Station

Customer complaints arise regarding the reliability of emission test results, especially in cases where a vehicle fails an emission test after the recommended repairs have been performed. In order to resolve complaints of this nature, a referee station is used. The use of a referee station provides an additional check on emission test facility instrumentation, engine diagnosis, and mechanic capability. For customer convenience, as an alternate, mobile test units could be used as referee stations. Upon receipt of a customer complaint and request for verification of emission test results, an appointment is made to conduct the verification test at the test facility in question. To avoid an overload on the system, specific criteria have to be developed to single out complaints for verification testing. For example, vehicles which have failed after the recommended repairs were performed and/or vehicles for which the recommended repair costs are above some predetermined level would be eligible for verification testing.

E.3.1.2 Correlation Car

In addition to the regularly scheduled calibration checks, correlation vehicles with a known level of emissions could be used to further standardize the station-to-station equipment complements. The correlation vehicle is altered in such a way as to reduce to a minimum those parameters that might cause variations in the emission levels due to inconsistent energy demands on the engine (e.g., power brakes, air conditioning, fuel composition, fuel temperature, etc.). An emission test performed using a highly standardized correlation vehicle provides a quality check on the entire analytic system of anlayzer, sample collection system, tachometer and inspection personnel.

E.3.2 ASPECTS OF DECENTRALIZED I/M CONSUMER PROTECTION

The chances are great that conditions exist in a decentralized I/M program which may prevent motorists from receiving an accurate emissions test. For example, there is limited standardization of inspection procedures, equipment maintenance, and calibration schedules from one garage to another. In addition, garages are also subject to time and cost pressures on the use of a bay for inpsections. Although the decentralized inspection program can incorporate additional consumer protection components, some consumer dissatisfaction may still result from the lack of consistency in the enforcement of emission standards among garages.

Methods to compensate for the lack of standardization of equipment calibration and inspection procedures are discussed below.

E.3.2.1 Challenge Garage

A challenge garage, similiar to a referee station, is a State-operated facility where vehicle owners may obtain an independent emissions test to compare to a test from a licensed station. U.S. EPA has specified that at least one referee station must be present in each I/M metropolitan area where a decentralized program is in effect. There are no requirements for the size of the facility; thus it may take the form of a garage bay, a mobile van, or even a portion of a parking lot, so long as the test methods are sound. Providing a referee station will give motorists an opportunity for an objective inspection, independent of any special interests of the repair industry. The challenge garage may also be a center for handling consumer complaints relating to the diagnosis and repair of vehicle emissions malfunction.

E.3.2.2 Garage Inspection Program

By making periodic inspections, the State garage inspectors can verify that the garages' equipment is calibrated, is in proper working order, and can provide accurate test results. This activity is a necessary element in a decentralized inspection program. Without surveillance, the garages may allow their testing procedures and quality control to slip. The correlation of instrument readings among inspection facilities should also be checked at this time.

E.3.2.3 Garage/Inspector Licensing Program

Garage and inspector licensing ensures that the individual conducting inspections at the garage has received instruction in the proper use of the emissions analyzer and in vehicle testing methods. Licensing of the garages, in addition, ensures that all garages have proper analytical instrumentation and sufficient space to provide inspections.

E.4 QUALITY ASSURANCE FOR TESTING

Maintaining uniformity and high precision in emissions testing is vital to the successful implementation of any inspection/maintenance program. The reliability of the test procedure is central to the issue of quality assurance. The generation of accurate information is necessary to correctly assess the effectiveness of the program in lowering emissions from motor vehicles and maintain public interest and participation in the program. If I/M is perceived as an arbitrary and haphazard program, enforcement problems will be encountered.

There are two essential aspects of quality assurance. They are (1) establishment of inspection and maintenance equipment standards, and (2) inspection system quality assurance. The first aspect seeks to assure from program start-up the adequate performance of testing equipment and the neutralization of problems associated with the analysis of vehicle exhaust gas emissions. The second aspect involves the development of a plan to repeatedly ensure the proper operation of these instruments.

E.4.1 INSPECTION AND MAINTENANCE EQUIPMENT CONSIDERATIONS

Equipment considerations are classified and discussed according to two categories: sample collection system considerations and gas analyzer considerations. The sample collection system and gas analyzer considerations deal with various technical problems and solutions associated with the analysis of vehicle exhause gas emissions.

E.4.1.1 Sample Collection System Considerations

Because exhaust gases are extremely complex mixtures of HC, CO_2, CO, NO_x, aldehydes, particulates, water, nitrogen, oxygen, hydrogen, and many other compounds, the application of proper gas sampling tecniques and careful sample handling treatment prior to instrument analysis are necessary to measure any single pollutant accurately. The basic consideration is to obtain a sample of exhaust gas which is completely representative of the vehicle exhaust for the operating condition of interest.

Therefore, it becomes necessary to selectively remove those materials and compounds which affect the absolute measurement of the subject pollutant without changing the concentration or characteristics of that pollutant. In a practical sense, this generally means reducing the water vapor level in exhaust gases and filtering out the particulates before passing the gas sample through a measuring instrument. Additionally, the sample handling system should also provide for the periodic inputting of zero and span check gases and calibration gases.

In order for a system to effectively perform those operations, the following items should be considered when making a sample collection system selection:

- Avoidance of materials that are subject to corrosion and deterioration.
- Adequate flow rates for fast system response.
- Rugged construction of sample lines and probes to withstand heavy usage.
- Filtering system of adequate capacity and serviceability.
- Adequate provisions for water removal.

E.4.1.2 Gas Analyzer Considerations

The heart of any automobile exhaust emission test system is the instrument component required to measure the levels of pollutants. Depending on the type of test being conducted, the analyzers vary from relatively simple and inexpensive to highly sophisticated.

A large number of sophisticated exhaust gas analysis systems have been assembled and used in research programs and in the certification and quality audit of new cars to evaluate their compliance with state and federal standards. At the other end of the spectrum, some relatively simple analyzers are being used by garage mechanics and tune-up technicians to assist in adjusting engine operating parameters during maintenance. The instrument system required in a mandatory inspection program probably lies somewhere between these extremes.

An important consideration in the selection of the instrumentation is the wide range of values required to measure HC concentration in the various modes of vehicle operation. During vehicle testing, HC concentrations of a few thousand ppm are commonly observed and, occasionally, values in excess of 10,000 ppm are observed. Conversely, observed values of less than 50 ppm are common in the exhaust of well adjusted 1972 and 1974 emission controlled cars operating in steady-state modes; even lower values are observed with 1975 and later vehicles.

For the I/M exhaust emission program, the NDIR analyzer is probably the choice because it is reasonably stable and trouble free. Calibration maintenance procedures are well defined and their effectiveness well established. Many thousands of these instruments, produced by several major manufacturers, are being used very successfully in automotive exhaust emissions analysis.

For the final analyses, the selection of HC instrumentation depends on the degree of measurement accuracy and ranges required based on an evaluation of the exhaust emissions inspections standards established by the state.

E.4.2 INSPECTION SYSTEM QUALITY ASSURANCE

A plan should be developed to daily ensure the proper operation of inspection instruments. Such a plan could be divided into four components. Those are (1) daily operational checks and adjustments, (2) scheduled preventive maintenance, (3) major maintenance and repair, and 4) periodic instrument calibration checks. The first two components are classified as routine, as required procedures and are performed during normal working hours by inspection facility personnel. Major maintenance should be available on an on-call basis by fully trained service personnel supplied by the appropriate instrument manufacturing company. The major maintenance service personnel should repair and overhaul major equipment and have available a complete stock of spare parts and major equipment replacement units. Periodic instrument calibration checks need to be performed by qualified state inspectors dispatched from a central state-operated facility. The state inspectors could conduct the calibration checks using a fully equipped mobile test unit or a correlation vehicle.

E.4.2.1 Daily Operational Checks and Adjustments

Daily operational checks of the vehicle inspection system can be performed by inspection facility personnel prior to opening for business. The three daily checks are for (1) NDIR Gas Analyzer, (2) Sample Handling, and (3) gas supply.

The NDIR gas analyzers require initial zero and span check to verify that the test lane operational status is according to specifications. These gas analyzers must be zeroed and spanned manually at the beginning of each work shift by the supervising inspector or surrogate. For the remainder of the shift, the inspector can then compensate for minor zero or span shifts once every six tests. Repeated zero and span drift error usually means that the analyzer requires preventive maintenance.

At the beginning of each shift, the temperature of the calibration gas water bath should also be checked and adjusted as required. The pressure and flow of the exhaust sampling system should be checked and adjusted to specified values by the supervising inspector or other inspection personnel. Cylinder pressure of the working gases (zero and span for the NDIR analyzer) also needs to be checked each shift, and new cylinders should be installed by the facility personnel if the pressure drops below 100 PSI.

E.4.2.2 Scheduled Preventive Maintenance

Preventive maintenance of the vehicle inspection system should be accomplished on a scheduled basis and integrated into the daily operational checks by an inspection facility's supervising inspector. Preventive maintenance for the sampling system should be performed at the beginning of each shift. The tail pipe sample probe and sample line must be checked for damage and restricted sample flow. The water trap and aspirator are checked for deposits, along with the exhaust gas filter.

E.4.2.3 Major Maintenance

Those system problems which are easily handled by the station personnel can be addressed either of two ways. A repair staff could be retained at the regional level, or major problems could be referred to the manufacturers themselves. In either case, equipment downtime must be kept to a minimum.

E.4.2.4 Periodic Calibration Checks

Periodic calibration checks should be performed at specified intervals by qualified state inspectors. The state inspectors can operate out of a mobile test unit dispatched from a centrally located state facility. The mobile test unit must be equipped with an NDIR gas analyzer, remote tachometer, one percent calibration gases, tachometer calibrator, and field-type diagnostic equipment. In a decentralized program, the calibration checks would be prearranged to allow for scheduled downtime.

E.5 PROTECTION FOR MOTORISTS WHO FAIL INSPECTION

Consumer protection mechanisms for motorists who fail inspection may be divided into two categories. The first category is comprised of specific active procedures set up to deal with consumer complaints as they occur. These include consumer hotlines and diagnostic checks for redundancy. The second category consists of features built into the system which protect consumers from inequities or abuses. Some of the elements included under this category are

1. Maximum repair cost limit;
2. Private garage analyzer testing by state authority; and
3. Confirmation of manufacturer's specification tuning at the referee station.

The elements in each category are discussed below.

E.5.1 CONSUMER HOTLINES

Consumer hotlines serve the purpose of providing information to the consumer as well as a central source where complaints regarding any procedural aspects may be registered. In some cases, a complaint can be resolved by phone merely by providing the correct information, while in other instances the complaint may have to be referred to another department for proper follow-up. If the complaints seem to be generated from one predominant source, a spot investigation would alleviate the problem before it mushrooms. Thus, consumer hotlines can contribute to the overall public information effort.

The Department of State, Bureau of Automotive Regulation, currently maintains a toll-free number for registering complaints in regard to vehicle repair. This service should be expanded to handle complaints arising from vehicle emissions testing and repair services. Present personnel could be utilized for this purpose with additional training. The current toll-free number could be utilized by consumers for both obtaining information and registering complaints. Records of all complaints and the follow-up action should be maintained on paper or computer tape.

E.5.2 DIAGNOSTICS

In the event of an inspection failure, the States of Arizona and California both provide diagnostic information on the probable cause of failure. The purpose of this diagnostic information is to provide a guide for both the repair mechanic and the owner of the vehicle. The mechanic saves a substantial amount of time which would have been spent searching for the cause of failure, thereby resulting in a lower labor charge, and the consumer can determine justified repairs in contrast to unnecessary repairs which are performed in the guise of emission control.

For example, the major causes of elevated hydrocarbon emissions are improper timing, ignition system malfunction, and malfunction of emission control devices. In no way is any repair to radiator or brakes connected with possible emissions reductions. However, an ordinary motorist not familiar with the inner workings of an automotive system might be convinced of such a relationship by a mechanic, resulting in a higher bill for the consumer.

Table E-1 lists the most common systems and components, ways in which their operations can vary, and the resultant effect on carbon monoxide and hydrocarbon emissions. (See Appendix C in Volume I)

Table E-1. EFFECT OF ENGINE COMPONENT OPERATION ON EMISSIONS

COMPONENT	Change in Emissions	
	Carbon Monoxide	Hydrocarbon
Decreased air-fuel ratio	Increase	Increase
Decreased engine idle speed	Increase	Increase
Restricted PCV valve	Increase	Increase
Restricted air filter	Increase	Increase
Choke malfunctions	Increase	Increase
Carburetor malfunctions	Large Increase	Increase
Ignition system malfunctions		Large Increase
Advanced spark timing		Decrease
Stuck heat riser valve	Increase	
Exhaust valve leak		Increase
Intake manifold leaks	Increase	Increase
Emission control device malfunction	Increase	Increase
Catalytic converter breakdown	Large Increase	Large Increase

Source: U.S. Environmental Protection Agency

E.5.3 MAXIMUM REPAIR COST

Repair cost limits were discussed to a limited extent in Appendix B (subpart C.3.10). To reiterate, the repair cost limit is a maximum dollar amount that a motorist is obligated to spend on repairs for his/her motor vehicle in order to meet the emissions standards. This cost ceiling prevents I/M from becoming a severe penalty on vehicle owners in lower income brackets. On certain vehicles, the cost of repairs might exceed the book value of the car, rendering such repairs economically infeasible.

Repair cost ceilings are generally of two types. In the first case, an absolute dollar limit is set. Thus, all vehicle owners, regardless of the age or resale value of their cars, need spend only up to the absolute limit in the event of a failure. In the second case, the maximum repair limit is determined as a percentage of the vehicle's average retail price (i.e. NADA's Blue Book value).

Large-scale I/M programs presently in operation all have built-in repair cost ceilings, with an upper limit of $50 being most common. Data shown in Table E-2 indicate that this limit covers 80 to 90 percent of the average repair cost. It should be noted, however, that a $50 limit is low in term of 1978 costs in that it may fail even to cover the cost of an engine tune-up.

It is recommended that the State of Michigan carefully consider a cost ceiling prior to the implementation of the I/M program. It might be more equitable, though more costly, to choose the type of ceiling in which the dollar limit is computed on the basis of a vehicle's book value. This second option would allow more flexibility for the individual motorist and would be no more difficult to enforce.

Table E-2. REPAIR COST SUMMARY FOR EXISTING I/M PROGRAMS

NEW JERSEY		OREGON	
Less than $10	29.7%	No cost	27%
$10 to $25	26.4%	Less than $10	37%
$25 to $50	22.1%	$10 to $30	18%
$50 to $100	16.1%	$30 to $50	8%
More than $100	5.6%	$50 to $75	5%
		More than $100	2%
N = 16,000 Avg. repair cost = $32.40 Median: 50% of repairs cost less than $20 65% of repairs cost less than average		N = 1,400 (primarily newer cars) Avg. repair cost = $16.00 Median: 50% of repairs cost less than $8 71% of repairs cost less than average	

ARIZONA	
Less than $5	27%
$5 to $10	17%
$10 to $25	24%
$25 to $50	20%
$50 to $100	10%
More than $100	2%
N = 2,000 Avg. repair coat = $23.40 Median: 50% of repairs cost less than $15 64% of repairs cost less less average	

Source: U.S. Environmental Protection Agency

E.5.4 PRIVATE GARAGE ANALYZER TESTING BY STATE AUTHORITY

The discrepancy between test result readings of emission analyzer equipment in use at garages where vehicles are repaired and those of the equipment at emission testing stations has been a cause of concern in many states with I/M presently in effect. The State of Arizona has taken the lead in seeking the causes of this discrepancy. In the fall of 1978, Arizona instituted a program in which all garage analyzers are tested at least once every 60 days. The reason for Arizona's undertaking this program was growing public dissatisfaction with the numerous trips between inspection stations and repair garages arising from incongruous emission test output. Arizona's program has revealed that emission readings of private garage analyzers vary by as much as 30 to 40 percent from the true value.

Some example variance plots from one garage analyzer monitored by the Quality Assurance Section of the Arizona Department of Health Services is shown in Figures E-1 through E-4. As is apparent from these sheets, low range CO (0 to 2 percent) is generally the least affected by inaccurate readings, whereas high range HC (1,000 to 1,600 ppm) is the cause of greatest concern. Poor in-shop maintenance of the analyzer, lack of outside maintenance services, and general carelessness of the garage personnel has been blamed for these discrepancies. It is not unusual for garage repair personnel to leave the analyzer probe on the floor where it can gather dust and grime and be driven over by vehicles. This contamination and abuse negatively affect the accuracy of the analyzers to a significant degree. It has been calculated that 40 percent of analyzer variance problems are associated with damage to the probe.[1]

The State of Michigan should consider adding private garage analyzer testing to its quality assurance program. Guidelines should be established which set forth the procedures for calibrating garage analyzers

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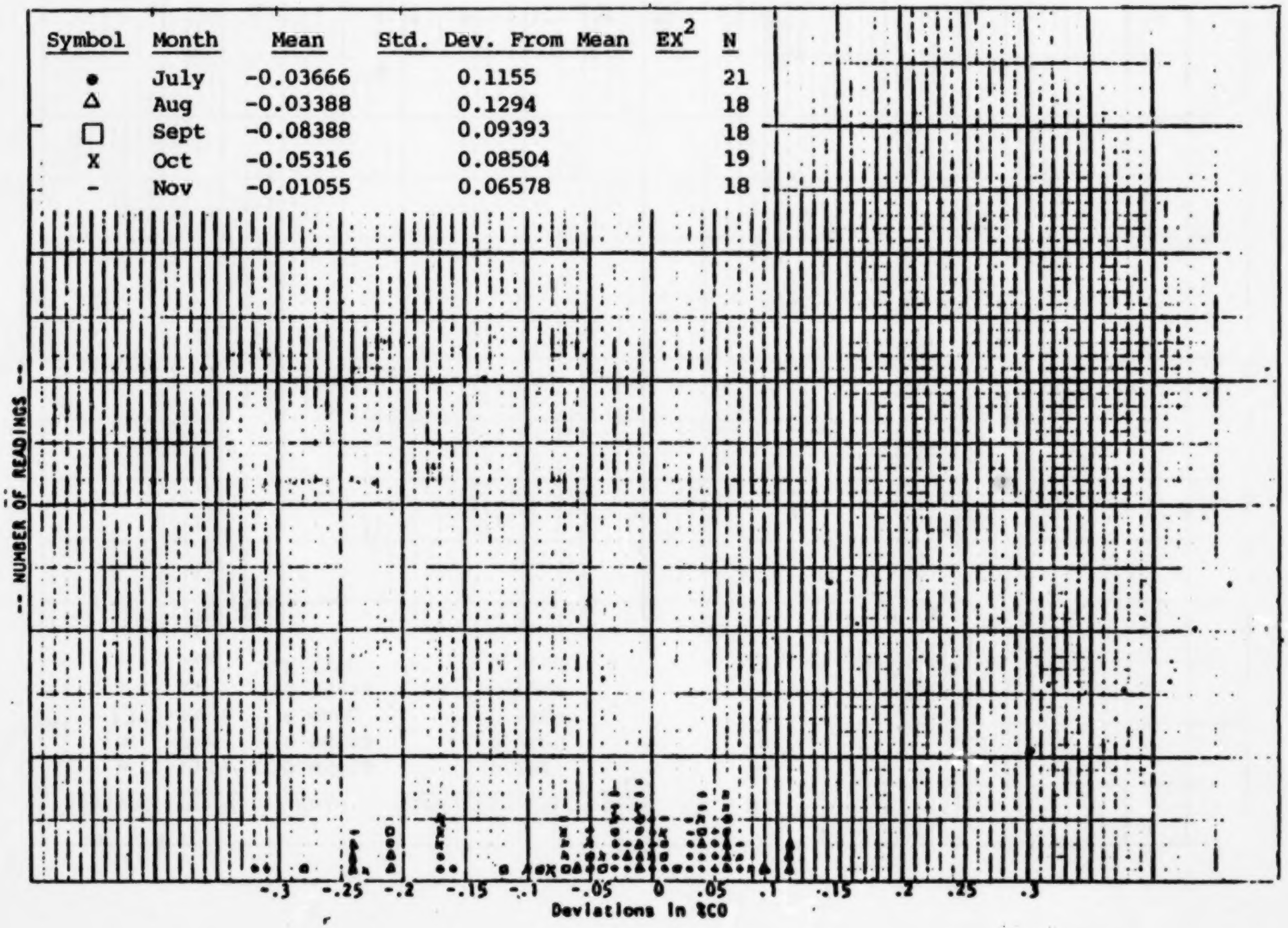
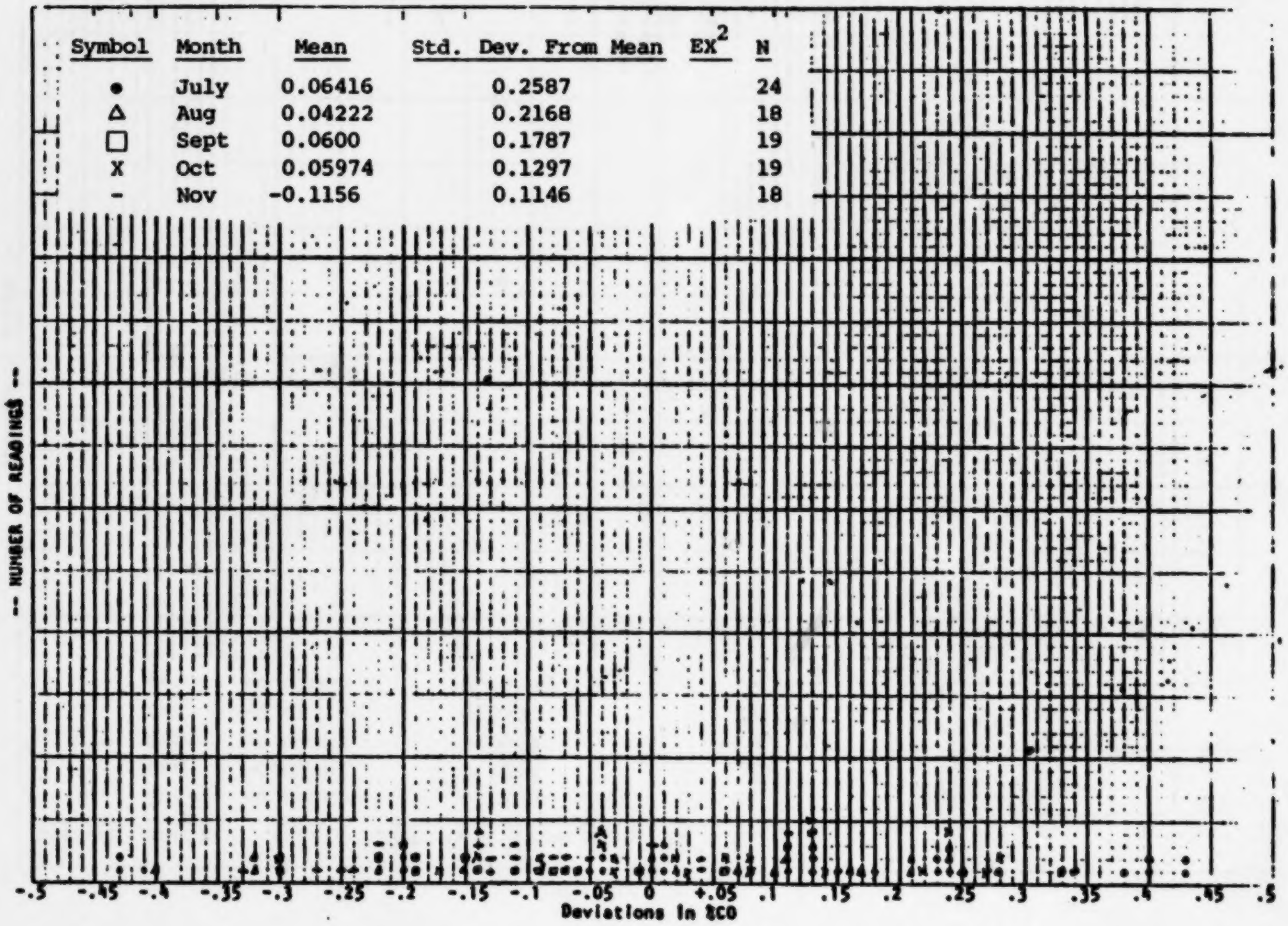
[1] Mr. William F. Price, Manager, Quality Assurance, Arizona Bureau of Vehicular Emissions Inspection



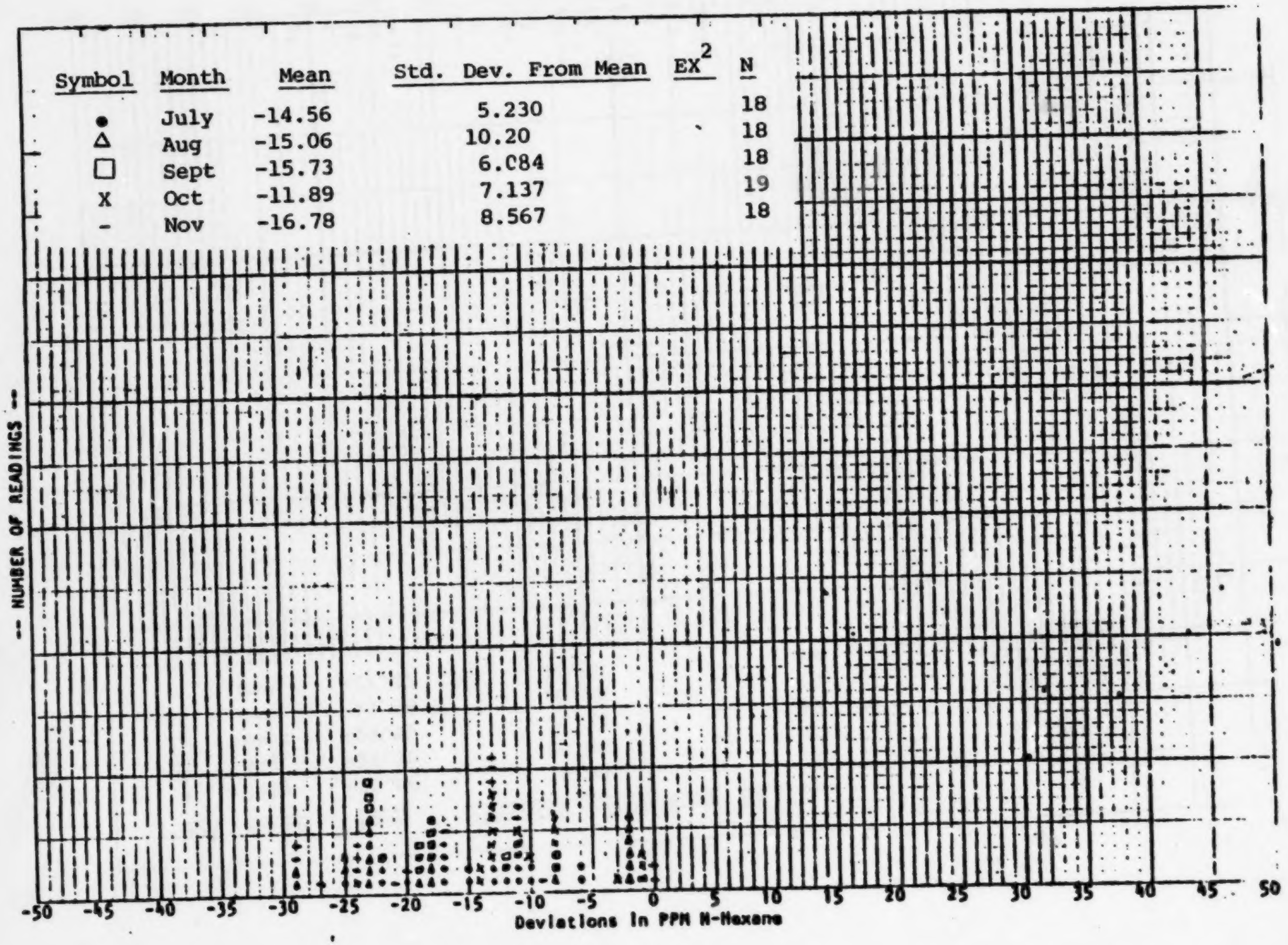
Symbol	Month	Mean	Std. Dev. From Mean	EX^2	N
●	July	-0.03666	0.1155		21
△	Aug	-0.03388	0.1294		18
☐	Sept	-0.08388	0.09393		18
X	Oct	-0.05316	0.08504		19
-	Nov	-0.01055	0.06578		18

Figure E-1. Example of Deviation in Low CO Concentration in Garage Analyzer



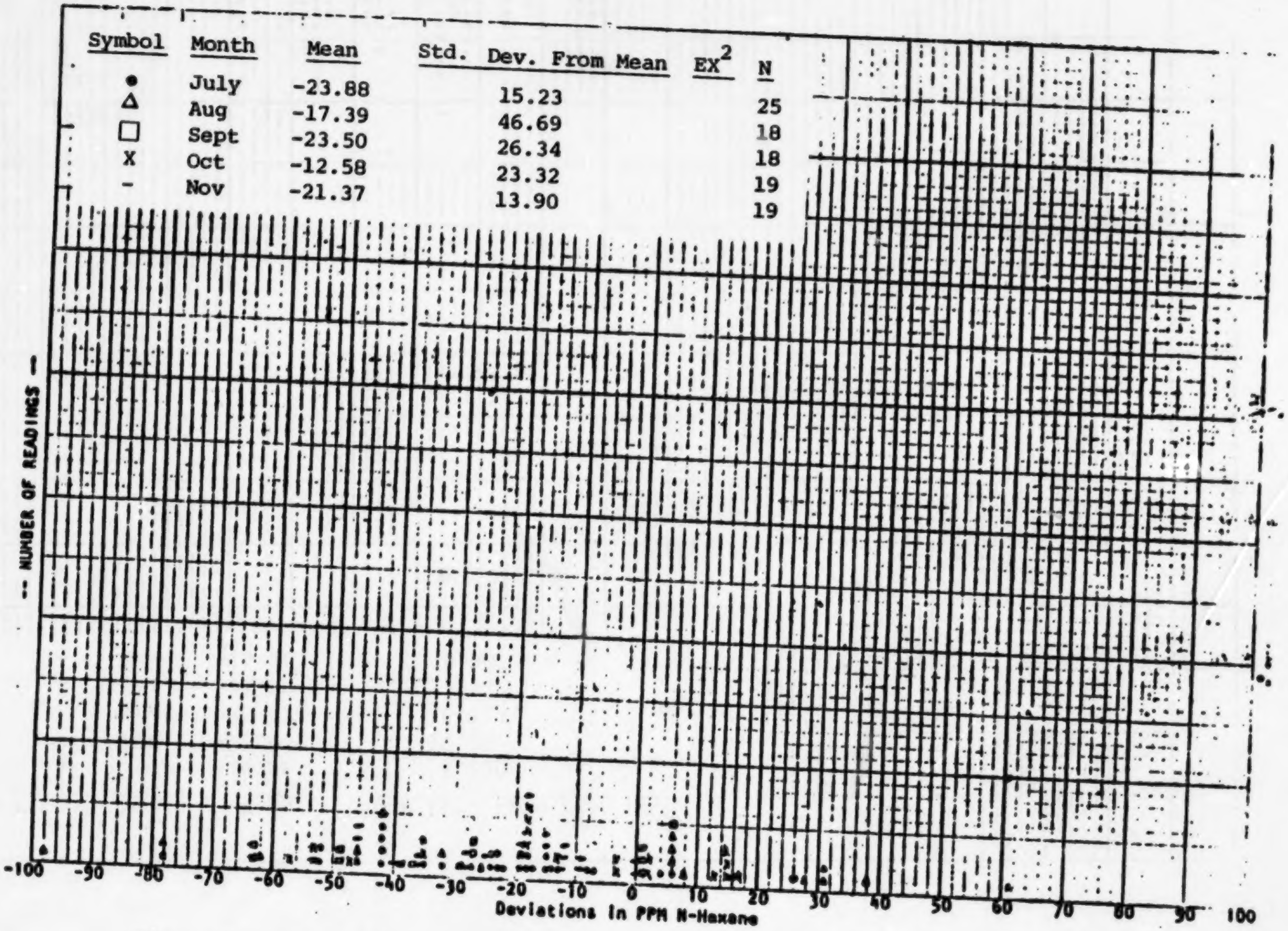
Symbol	Month	Mean	Std. Dev. From Mean	EX^2	N
●	July	0.06416	0.2587		24
Δ	Aug	0.04222	0.2168		18
☐	Sept	0.0600	0.1787		19
X	Oct	0.05974	0.1297		19
-	Nov	-0.1156	0.1146		18

Table E-2. Example of Deviation in High CO Concentration in Garage Analyzer



Symbol	Month	Mean	Std. Dev. From Mean	EX^2	N
●	July	-14.56	5.230		18
△	Aug	-15.06	10.20		18
□	Sept	-15.73	6.084		18
X	Oct	-11.89	7.137		19
-	Nov	-16.78	8.567		18

Figure E-3. Example of Deviation in Low HC Concentration in Garage Analyzer



Symbol	Month	Mean	Std. Dev. From Mean	EX^2	N
●	July	-23.88	15.23		25
Δ	Aug	-17.39	46.69		18
□	Sept	-23.50	26.34		18
X	Oct	-12.58	23.32		19
-	Nov	-21.37	13.90		19

Figure E-4. Example of Deviation in High HC Concentration in Garage Analyzer that would be followed by garage proprietors themselves. This measure would allow the State to increase the interval between visits to each garage facility for the purpose of checking analyzer performance.

E.5.5 MANUFACTURER'S SPECIFICIATION TUNING

It has been demonstrated that in order to obtain the lowest possible emissions readings, a car must be tuned to the manufacturer's specification. However, a significant number of mechanics prefer to tune a vehicle to their own standards of what produces optimum performance. These standards tend to be different from manufacturer's specifications.

If a vehicle goes through the entire I/M process and returns to the referee station, the state personnel should determine the procedures and specifications followed by the repair mechanic. This can be time-consuming for these personnel. Part of the problem will be alleviated through the mechanics training program. However, careful record-keeping by the state should single out the shops and/or mechanics who are not following prescribed procedures and specifications, in which case a follow-up visit by quality assurance inspectors would be appropriate.

Figure E-5 illustrates the examination report form currently in use at State of Arizona referee stations. This form records whether a failed vehicle was tuned to manufacturer's specifications, and could be used to identify repair facilities at which proper tuning procedures are not followed.

E.5.6 REPAIR FACILITY CERTIFICATION

The certification of repair facilities for emission work could be substituted for some of the activities previously mentioned. The repair facility certification process is meant to serve two basic purposes. First, it gives vehicle owners some guarantee of the competence of the repair facility, and second, a quality work product

STATE INSPECTOR ____________ STATION NO. ________ DATE ________

VEHICLE LIC. NO. ________ VIN ____________ MAKE ________ YR ______

VEHICLE OWNER ____________________ PHONE NO. ________

ADDRESS ____________________________________

	HIGH CRUISE		LOW CRUISE		IDLE		DATE/ TIME
	HC (PPM)	CO (%)	HC (PPM)	CO (%)	HC (PPM)	CO (%)	
HTS Initial Inspection							
HTS Reinspection							
LAB (as-received)							
LAB (after adjustment)							

REPAIR FACILITY & ADDRESS ____________________ PH NO. ________

NDIR Registration No. ________ Estimated Repair Costs ________ Receipts ________

Claimed Work ____________________________________

Underhood Exam ____________________________________

____________________________________ Tampering? ________

LABORATORY EXAMINATION

	HC	CO	RPM (Tran)	DWELL	TIMING	(ADVAN)	PCV
As Received							
Mfg. Specs.							

COMPRESSION:

1______ 2______ 3______ 4______

5______ 6______ 7______ 8______

CID BBL TRANS

____

Reason for Failing Reinspection:

A/F ADJ.	RPM	TIMING	PLUGS	WIRES	DIST.	VAC. LK.	INT. CARB.	ENG. MECH.

Other ____________________________________

Technician Comments ____________________________________

____

EXAM RESULTS:

Waiver Returned? ________ DATE: ________ STATE TECHNICIAN: ____________

Figure E-5. State of Arizona's Examination Report must be assured by the facility for it to retain its certification. Criteria such as employment of a master mechanic or a tune-up specialist along with the availability of an emission analyzer could be established in order for the facility to be eligible for certification.

The State of Michigan presently requires each repair facility to file a certificate with the Bureau of Automotive Repair. Additionally, it requires each facility to employ at least one speciality or master mechanic certified in each category of repair that the facility provides. This existing regulation with an additional requirement should be sufficient to guarantee a competent repair facility. The amended regulation should require that every facility specializing in tune-up be able to demonstrate the availability of an emission analyzer in order for that facility to obtain certificate renewal.

E.6 MECHANISMS TO MINIMIZE CIRCUMVENTION OF SYSTEM

This aspect of consumer protection is intended to preclude the inequities caused by drivers who should have their vehicles repaired but who avoid test failure through some form of cheating. Subversion of the program in this manner is unfair to individual drivers who have undergone repairs in order to comply with emission standards,because the contribution to clean air for which they have paid is neutralized by the added pollution generated by cheaters. Protection against such acts may be provided by procedural mechanisms. Some of these mechanisms are discussed below.

E.6.1 DUMMY TAILPIPE CHECKS

In order to secure a reduced emission reading during vehicle inspections, some motorists may weld a second tailpipe onto the vehicle exhaust system, and by creating dual channels, thus dilute the exhaust gas concentration measured in one tailpipe. This can also be accomplished by introducing a diverter valve in the exhaust system, which permits some of the emissions to escape prior to reaching the test probe. Both techniques have the effect of reducing the concentration of regulated pollutants, thereby permitting a vehicle to pass which should have failed.

There are two methods of identifying such abuses. First is a simple visual check by the inspector prior to inserting the analyzer probe. Second is a safeguard built into the emission analyzer itself. This sets the analyzer to monitor carbon dioxide (CO_2) during the inspection. In the event of change in CO_2 concentration, the HC and CO readings are adjusted conversely through carbon mass balance. If results of the mass balance are incompatible with meter readings, the test is voided.

E.6.2 "MERRY-GO-ROUND" DRIVERS

This scenario involves a motorist driving around from one testing lane or facility to another until he/she passes inspection. This should be of special concern to officials since such activities create doubts in the mind of the general public as to the accuracy and purpose of the emissions inspection.

A majority of existing programs have combatted this problem by providing only one free retest and requiring the same fee as the original test for subsequent tests. This discourages vehicle owners from having multiple inspections without undergoing repair, particularly as the cumulative testing fee approaches the likely repair cost. Another method utilized by some states requires the motorist to present evidence of repair in the form of a receipt or filled-out test registration form from the repair mechanics or a receipt for parts purchased if repairs are performed by the owner himself. This form describes the diagnostic information and corresponding repair. Without such evidence, the retest is not performed.

E.6.3 REGISTRATION IN COUNTIES OTHER THAN THAT OF RESIDENCE

This aspect of the valid testing problem has been discussed to a limited extent under Appendix B (Section B.3.12). The likelihood for vehicle registration outside a control area by residents of that area is high if I/M program coverage is not statewide (i.e., limited to certain counties). Vehicle owners residing in the affected counties may register using the address of a relative or friend living in non-I/M counties. Temptation to do this may be greater for drivers residing on the fringe of the control area.

The problem of circumventing the inspection requirement could be alleviated by including a penalty provision in I/M legislation, as the State of Arizona has done. Furthermore, a cross-reference check could be made through computerized data files every year, checking the owner's address against the address of his or her vehicle registration. A notification to subject vehicle owners listing their responsibilities and the penalties for fallacious registration should promote compliance with the law.

Appendix F

UNIT COST DATA USED IN COST ANALYSIS

Appendix F

UNIT COST DATA USED IN COST ANALYSIS

This appendix provides the detailed cost data used in analyzing costs of various program options. Data are presented in the order of cost elements listed in Table F-1 and are grouped into three major categories:

- Initial Implementation and Capital Costs (Section 1)
- Annual Operating Costs (Section 2)
- Ancillary Programs Annual Operating Costs (Section 3)

A summary of cost data is presented in Section 6. All cost data are expressed in 1978 dollars. They were developed from the Dodge[1] report, inputs from State of Michigan, and other existing I/M program data. Costs presented represent average prices. The assumptions used in the development of these costs were:

- No volume or special discounts are available for materials, equipments, and land.
- Standard grade materials will be used.
- There are no labor cost premiums due to the shortage of skilled personnel.
- Labor wage rates used include: base rates plus fringe benefits of 25 percent.[2]

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[1] 1979 Dodge Manual for Building Construction Pricing and Scheduling, McGraw-Hill Information Systems Company, N.Y., N.Y. 1979.

[2] Provided by the State of Michigan.

Table F-1. COMMON SET OF COST ELEMENTS

ITEM — COST ELEMENT

- I. INITIAL IMPLEMENTATION AND CAPITAL COSTS (NONRECURRING)
  - A. Initial Implementation Costs
    1. Site Selection
    2. Bids Preparation and Evaluation
    3. Facilities Design
    4. Training Plan Development
    5. Personnel Selection
    6. Document Preparation
    7. Administrative Support
    8. System Integration, Checkout, and Certification
    9. Test Scheduling System Development
  - B. Capital Costs (Construction)
    1. Land and Site Improvement Costs
       - a. Land Cost
       - b. Site Improvement Costs
    2. Facility Construction
    3. Instrumentation Cost
    4. Office Equipment
    5. Computer Costs
       - a. Hardware
       - b. Software
  - C. Capital Costs (Other)
    1. Administrative Office Equipment
    2. Quality Control Equipment
       - a. Mobil Unit
       - b. Referee Station
       - c. Correlation Car
    3. Consumer Complaint
- II. ANNUAL OPERATING COSTS
  - A. Facility Operating Costs
    1. Personnel Costs
    2. Maintenance and Miscellaneous Item Costs
       - a. Facility
       - b. Equipment
  - B. Support Costs
    1. Administrative
    2. Data Analysis
    3. Training
  - C. Quality Control Operating Costs
    1. Personnel
    2. Supply
    3. Maintenance
- III. ANCILLARY PROGRAMS ANNUAL OPERATING COSTS
  - A. Ancillary Program Costs
    1. Mechanic Training
    2. Public Information Program
    3. Consumer Complaint
    4. Vehicle Test Scheduling Costs

F.1.1 IMPLEMENTATION AND CAPITAL COSTS

F.1.1.1 Initial Implementation Costs (Start-Up Costs)

Implementation of an I/M program will require program planning, design, and development. Costs of these noncapital cost items are difficult to quantify. Included here are those administrative costs that are necessary to support facility construction, program coordination in the initialization phase. These costs are identified in Table F-2 and the cost item is identified, according to the responsible party for each administrative option. For those indirect costs associated with implementation efforts, such as legislation, etc., a bottom line G/A and/or overhead percentage will be applied.

Table F-2. COST ITEMS OF PROGRAM IMPLEMENTATION

	ADMINISTRATIVE OPTIONS				
		Contractor-Operated		Private Garage-Operated	
COST ITEMS	State-Operated	State	Contractor	State	Service Center
Site selection	x	x	x	-	-
Bids preparation and evaluation	x	x		-	-
Facilities design	x		x	-	-
Training plan development	x	x	x	x	
Personnel selection	x	x	x	x	x
Document preparation	x	x		x	
Administrative support	x	x		x	
System integration, checking out, and certification	x	x	x	x	x
Test scheduling system development	x	x		x	

F.1.1.2 Site Selection

Based on the number and types of the inspection facilities, the land area required for station placement must be identified. This cost element includes:

● Establish guidelines for site selection	$5,000

- **Analysis for optimal site location**
  - **-consumer convenience**
  - **-site costs**
  - **-access** **$200 per site**

- **Travel associated with site selection per site**
  - **-manpower plus travel** **$200 per site**

Total cost = $400 per site + $5,000

F.1.1.3 Bids Preparation and Evaluation

All necessary performance specifications of the I/M program must be completed in the form of a Request For Proposal (RFP) so that contractors may submit bids. The bids must be evaluated, qualifications of contractors certified, and contracts drawn for the selected parties. Modifications to existing facilities would be handled somewhat differently; but the cost elements would remain basically the same. These costs include:

	MANUAL DATA HANDLING SYSTEM	AUTOMATED DATA HANDLING SYSTEM
a. Idle-Mode and Engine Parameter/ Device Inspection (EPDI)		
- RFP preparation	$ 3,000	$ 8,500
- bid package and distribution	2,500	2,500
- bid review and selection	3,800	3,800
TOTAL COSTS	$ 9,300	$14,800
b. Additional for Loaded-Mode	$ 4,600	$ 4,600
TOTAL COSTS	$13,900	$19,400

F.1.1.4 Facilities Design

Facilities must be designed to comply with the program requirements. In the case of established facilities, modification drawings must be prepared to

accommodate equipment and specify space requirements. These costs include the structural, architectural, mechanical, and electrical design of facilities that meet the requirements of each community. Normally this cost is 10 percent of the total construction costs per facility. However, because of similarity of facilities designs the estimated costs are reduced to 5 percent.

F.1.1.5 Training Plan Development

A training plan must be developed and would include theory of operation of the test equipment and the procedures to be followed during the conduct of the inspection at each of the work stations within a lane. Anticipated cost elements include the development of the training program, any equipment and documents essential to the training course, and class scheduling are:

a.	Idle-mode	$3,500
b.	Loaded-mode	5,000
c.	EPDI test	7,500

The cost was developed from course development in the State of California and from various training centers.

F.1.1.6 Personnel Selection

Based on the personnel requirements analysis conducted for each of the applicable option configurations, a complement of technical and administrative personnel is identified. The cost to staff the individual facilities would consist of those personnel costs to recruit and hire the complement of personnel needed for the program. These costs are:

Establish Requirements
  510 person hours x $20 per hour = $10,200
Advertise Personnel Vacancy
  40 person hours x $20 per hour = 800
Review and Select Personnel
  900 person hours x $20 per hour = 18,000
Advertisement Costs = 14,000
$43,000

F.1.1.7 Document Preparation

Document preparation include those costs associated with the clerical, editorial, and copying costs in developing a program plan and Project Evaluation and Review Technique (PERT) chart to record the plans, schedule, and analytical results associated with the planning and development phase. These costs are:

Document Preparation		
450 person hours x $20 per hour	=	$ 9,000
Reproduction	=	1,000
		$10,000

F.1.1.8 Administrative Support

Administrative support include those costs associated with the facility construction, equipment purchase, personnel selection, and system installation and checkout. These costs are:

5,200 hours x $30 per hour = $156,000

F.1.1.9 System Integration, Checkout, and Certification

System integration involves the interfacing of individual system elements, which may have been procured from different suppliers, and the testing of hardware and software as a total entity to establish compliance with procurement specifications. The average costs per facility are:

a. For Idle-Mode

Test individual equipment		
10 hours x $25 per hour	=	$ 250
Test Software		
10 hours x $30 per hour	=	300
Integrated test		
30 hours x $25 per hour	=	750
		$1,300

b. For Loaded-Mode

Test individual system elements

10 hours x $25 per hour = $ 250

Test all hardware

10 hours x $25 per hour = 250

Test all software

20 hours x $30 per hour = 600

Perform integrated test

40 hours x $25 per hour = 1,000

$2,100

c. For EDPI

Software test = $ 0

Hardware test

6 hours x $25 per hour = 150

Integrated test

38 hours x $25 per hour = 950

$1,100

Prior to receiving and testing the first vehicle, the entire inspection system must be evaluated and tested by the State to establish conformity to performance specifications. Station certification would consist of a statistical sample vehicle run to ensure satisfactory performance. The costs associated for initial system certification by test mode of each lane are as follows:

Idle-Mode (or EPDI Test Mode)

23.5 manhours x $25 per hour = $ 587

Loaded-Mode

27.5 manhours x $25 per hour = 687

F.1.1.10 Test Scheduling System Development

Initial computer software development cost for test scheduling will be $67,000. This estimation is based on inquiries of several software service companies.

F.1.2 CAPITAL COSTS (CONSTRUCTION)

Implementation of an I/M program requires initial investment in capital goods, such as test facilities, equipment, supportive hardware and software. Such investment applies only to the centralized inspection facility. For the decentralized private garage-operated inspection facility, the assumption was made that improvements or modifications are not required. Only the emission inspection equipment needs to be purchased. For the purpose of this report, test facility construction costs are separated into the following five major items:

- Land and Site Improvement
- Facility Construction
- Instrumentation
- Office Equipment
- Computer

F.1.2.1 Land and Site Improvement Costs

Land Cost - The land area required for station placement must be purchased if not already owned. This cost element requires special consideration, regardless if State- or private contractor-operated. In the case of the service centers, the construction costs are zero.

A number of issues, are extremely crucial in estimating land costs. The basic unit cost as established from real estate contacts is, for example, lot-specific to the extent that the cost per square foot within any mile square may vary by a factor of 3; within any city or town, the cost may vary by a factor of 10 or more.

Land cost used for this report was developed from information supplied by the State of Michigan. It represents average cost in 1978 dollars (Table F-3).

Table F-3. ESTIMATED PER SQUARE FOOT LAND COSTS FOR VARIOUS POPULATION AREAS

AREA CHARACTERISTICS	COST PER SQ. FT. NOMINAL VALUE
Major Metropolitan (greater than 1 million vehicles)	
urban	$5.97
suburban	4.02
rural	.50
Submetropolitan (between 200,000 and 1 million vehicles)	
urban	$4.02
suburban	1.00
rural	.11
Minor Metropolitan (less than 200,000 vehicles)	
urban	$2.00
suburban	.70

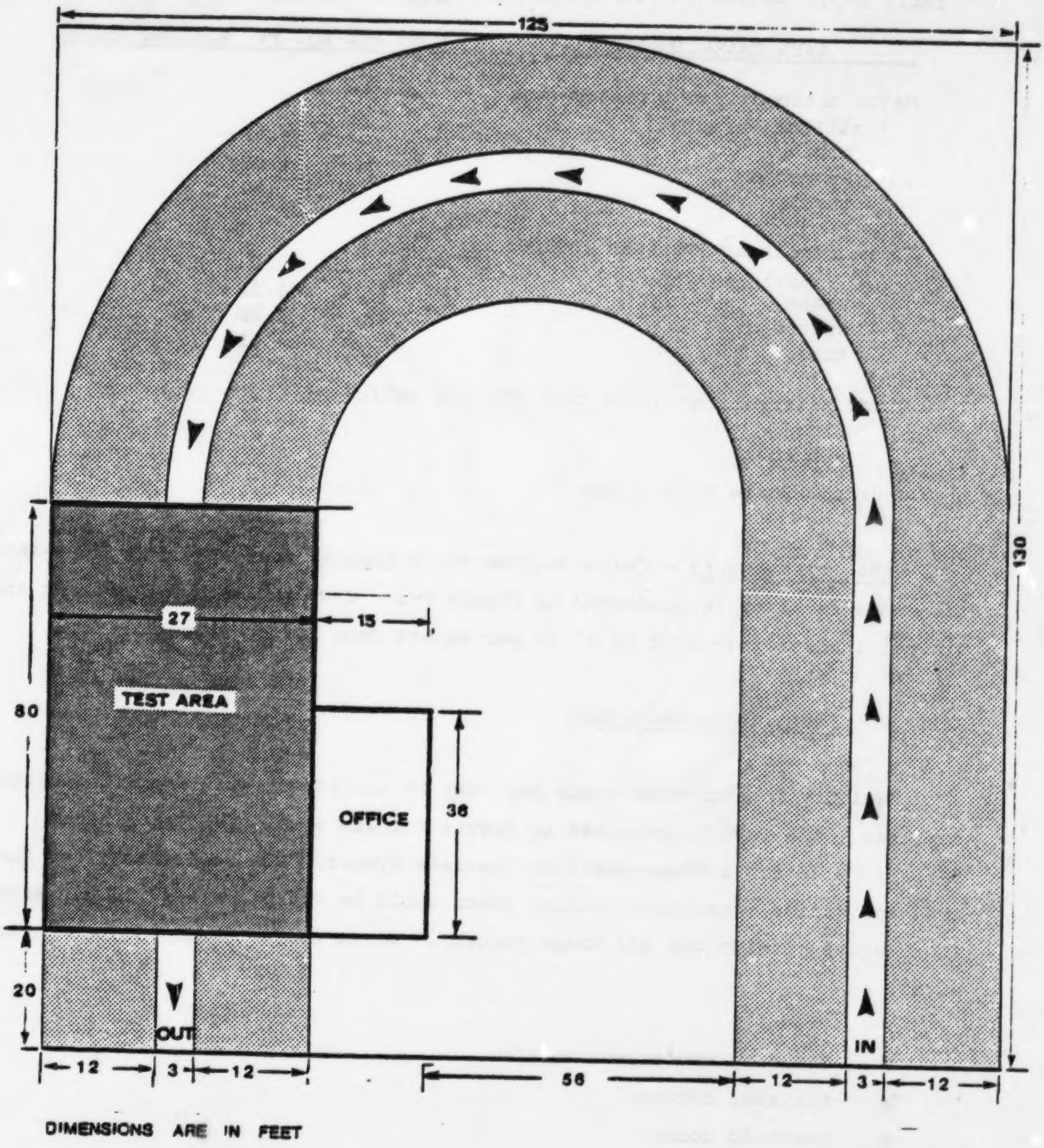
Source: State of Michigan

Site Improvements - The site plan for a typical three-position, two-lane idle-mode facility is presented in Figure F-1. Cost for site improvement and minimal landscaping would be $1.30 per square foot (Dodge Report).

F.1.2.2 Facility Construction

Facility construction costs may vary in accordance with specific design features. The layout presented in Figure F-1 was considered the minimal facility size for a three-position two-lane system. On the average, the test area and office space construction costs would be approximately $20 per square foot (State of Michigan and Dodge Report). Costs are estimated for a facility with:

- Concrete structure and floor
- Finished office
- Overhead doors
- Painted walls



125
130
27
15
80
TEST AREA
OFFICE
36
20
OUT
IN
12
3
12
56
12
3
12
DIMENSIONS ARE IN FEET

Figure F-1. Three-Position, Two-Lane, Idle-Mode Inspection Facility

Source: California Air Resource Board
SCI Evaluation Engineering

The same conceptual floor plan depicted in Figure F-1, with different size requirements, would be applicable to the one-lane facility and loaded-mode inspection facility. Facility space requirements are summarized as follows:

SPACE	IDLE-MODE		LOADED-MODE	
	One-Lane	Two-Lane	One-Lane	Two-Lane
Lot	14,300 sq. ft. (130' x 110')	16,250 sq. ft. (130' x 125')	14,300 sq. ft.	16,250 sq. ft.
Test Area	1,200 (80' x 15')	2,160 (80' x 27')	1,440 (80' x 18')	2,640 (80' x 33')
Office Area	540 (36' x 15')	540 (36' x 15')	540 (36' x 15')	540 (36' x 15')

The EDPI inspection facility has the same facility specifications as those of the idle-mode inspection facility. Land, site improvement, and construction costs of the different test mode inspection facilities are presented in Table F-4.

F.1.2.3 Instrumentation Cost

Primary Test Equipment - Equipment recommended for a particular test mode must be purchased and installed. The equipment and support instrumentation is interdependent with, and must be defined in terms of, the test mode and applicable exhaust emission standards. The inspection test system for an idle-mode testing facility will include an exhaust sample handling subsystem and analytical instruments. Depending on instrument specifications and measurement accuracy, cost of test equipment ranges from $2,300 to $18,000 (see Table F-5). A representative equipment of $3,000 per lane was used for this report. For loaded-mode test, an additional $16,500 per lane was used to include a dynamometer. The EPDI test requires diagnostic capability and special tools in addition to the regular idle test equipment. This amounts to an additional $6,000 per lane for EPDI test.

Ancillary/Maintenance Equipment - In order to ensure accurate test results, the instruments must be properly maintained and calibrated. Also

Table F-4.
SUMMARY OF INSPECTION FACILITY CONSTRUCTION COSTS
(IN 1978 DOLLARS)

COST ITEMS	IDLE/EPDI MODE		LOADED MODE	
	One-Lane Facility	Two-Lane Facility	One-Lane Facility	Two-Lane Facility
1. LAND				
Major Metropolitan				
urban	85,400	97,000	85,400	97,000
suburban	57,500	65,300	57,500	65,300
rural	7,200	8,100	7,200	8,100
Submetropolitan				
urban	57,500	65,300	57,500	65,300
suburban	14,300	16,300	14,300	16,300
rural	1,600	1,800	1,600	1,800
Minor Metropolitan				
urban	28,600	32,500	28,600	32,500
suburban	10,000	11,400	10,000	11,400
2. SITE IMPROVEMENT	18,600	21,200	18,600	21,200
3. BUILDING CONSTRUCTION	34,800	54,000	39,600	63,600

Table F-5. TEST EQUIPMENT PERFORMANCE SPECIFICATIONS (1978 Survey)

MODEL	MANUFAC.	OPERATING PRINCIPLE	SPECIFICITY	RANGE	ACCUR.	TEMPERATURE RANGE	HUMIDITY	SAMPLE SYSTEM	INITIAL COST
Mexa 300A	Horiba	NDIR	HC/CO	0-400/2000ppm 0-21/10%	3% FS	32°F to 105°F	95% RH	Filter water separator	$ 2,395
1836	Barnes Eng. Co.	NDIR	HC/CO	0-400/2000ppm 0-2/10%	±3% FS	30°F to 120°F		Filter	2,356
8335C	Barnes Eng. Co.	NDIR	HC/CO	0-400/2000ppm 0-2/10%	±3% FS	30°F to 120°F		Filter	2,494
590	Beckman	NDIR	HC/CO	0-400/2000ppm 0-2/10%	12ppm 0.06%	35°F to 110°F		Filter water trap	2,300
EPA 75	Sun	NDIR	HC/CO	0-500/2000ppm 0-2.5/10%	±2.5% FS	32°F to 120°F		2 filters water trap	2,750
2001	Sun	NDIR	HC/CO misc. computer	0-2000ppm 0-10%	±3% FS			2 filters 2 water traps	17,440
7050C	Autoscan	NDIR thermocouple	HC/CO	0-500/2000ppm 0-2/10%	±2% FS			Filter	2,425
23170	Allen	NDIR	HC/CO	0-500/2000ppm 0-2.5/10%	3% FS			2 filters water traps	2,371
200 Auto-sense	Hamilton Test Systems	NDIR	HC/CO misc. computer	0-2000ppm 0-10%	±3% FS	35°F to 110°F	10% to 90% RH	Filter water trap	16,000
42-076	Marquette	NDIR	HC/CO	0-500/2000ppm 0-2.5/10%	±3% FS	35°F to 110°F	85% RH	Filter water trap	2,425
400	Beckman	FID	Total HC	0-1/10/100/1000ppm	±16	32°F to 110°F	95% RH	Filter	2,820
951	Beckman	Chemi	NO/NO_x	0-10/25-10,000ppm	±0.5% FS				6,200
Mexa 240	Horiba	NDIR	NO/NO_x	0-1000/0-4000ppm	±1.0% FS				4,460

safety of operating personnel must be provided for. The ancillary/maintenance equipment includes:

● exhaust ventilation system		($5,000 per lane)
● hand tools		($1,300 per lane)
● remote tachometer		($ 100 per lane)
● tachometer calibration and working gas		($ 150 per lane)
Total additional cost per lane	=	$6,550 per lane

The cost estimates of ancillary/maintenance equipment are, in general, applicable to all test modes for the centralized options.

Private Garage-Operated Facility Instrumentation Requirements - Existing service centers, such as auto garages and gas stations, would need to acquire emission analyzers, dynamometers (for loaded-mode), and some accessories. The analysis presented in this report assumes all service centers would purchase necessary equipment. Cost estimates would be $3,656 per private garage bay for idle-mode (or EPDI test mode) and $20,156 per bay for loaded-mode. It is assumed that participating garages already have a diagnostic scope analyzer.

F.1.2.4 Office Equipment

There will be administrative support equipment required in the inspection facility to prepare inspection forms, record inspection data, and, where required, to record receipt of inspection fees and keep personnel records. Office furniture, equipment, and incidental office supplies will also be needed to complete the facility administrative office. Total cost assumed is $1,500 per facility independent of facility size and test mode.

F.1.2.5 Computer Hardware and Software

Hardware - For each facility, the costs of an automated system (single-processor) are presented in Table F-6.

Table F-6. STATION SUPPORT EQUIPMENT COST ELEMENTS AS NOTED

1. Semi-Automated (per lane)

Item	Number	Estimated Cost ($)
Keyboard input device	1	$ 2,000
Analyzer system[a]	1	5,000
Test condition display	1	4,000
Report printer	1	2,500
		$13,500

2. Automated (incremental cost per lane)

Item	Number	Estimated Cost ($)
Mini-computer CPU, Internal Memory, Operating Controls	1 Syst	12,000
Input/Output Teletype Paper Tape	1 Syst	7,000
Interface/Communications ADC, Multiplexer TTY Line Adapter Data Controls	1 Syst	7,700
Spares		300

[a] For loaded test mode there is a $4,460 additional cost for a NO_x analyzer (NDIR type), if required.

For an automated system, the approach is to use the central computer as an information retrieval and information storage system. Test control, decision processing, and data input/output could be regulated at each facility by a mini-computer as shown in Figure F-2. The operator would input an identification number to the central computer which would return the description of the vehicle to the operator display, and the test and decision parameters to the site processor. If the description matches the test vehicle, the operator gives his approval to proceed. The facility computer maintains control over the test until it is completed. The pass/fail decision would be made by the site processor, providing the appropriate outputs both on-site and to the central computer for inclusion in the vehicle's file. The central file is necessary for the mass storage of information on all cars tested in the city.

Software - The central computer would be one of the present on-line systems available in the State of Michigan. The costs, as established from contact of software companies and past experience, of developing a computer

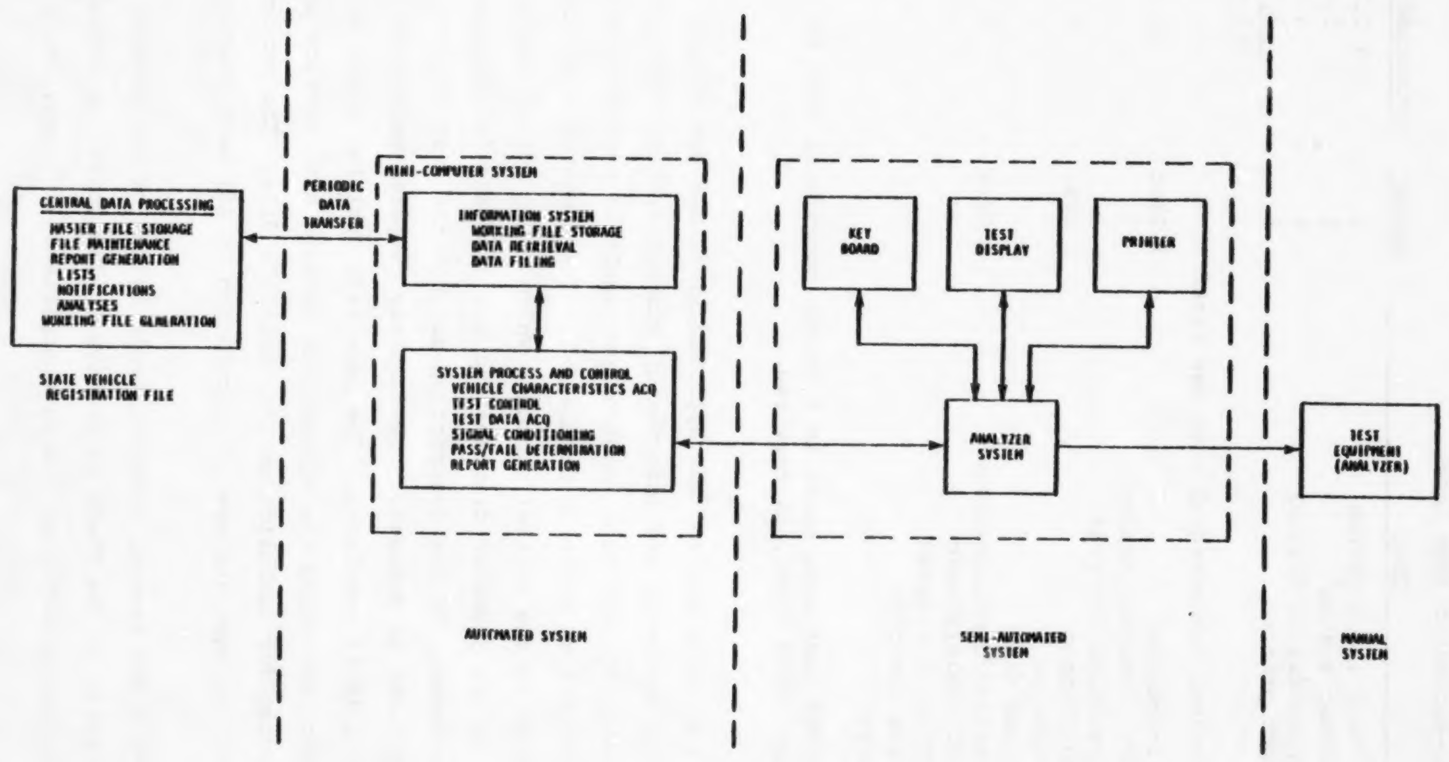

CENTRAL DATA PROCESSING
MASTER FILE STORAGE
FILE MAINTENANCE
REPORT GENERATION
LISTS
NOTIFICATIONS
ANALYSES
WORKING FILE GENERATION
STATE VEHICLE REGISTRATION FILE
PERIODIC DATA TRANSFER
MINI-COMPUTER SYSTEM
INFORMATION SYSTEM
WORKING FILE STORAGE
DATA RETRIEVAL
DATA FILING
SYSTEM PROCESS AND CONTROL
VEHICLE CHARACTERISTICS ACQ
TEST CONTROL
TEST DATA ACQ
SIGNAL CONDITIONING
PASS/FAIL DETERMINATION
REPORT GENERATION
AUTOMATED SYSTEM
KEY BOARD
TEST DISPLAY
PRINTER
ANALYZER SYSTEM
SEMI-AUTOMATED SYSTEM
TEST EQUIPMENT (ANALYZER)
MANUAL SYSTEM

Figure F-2. Test System Block Diagram

program to provide the input of between 75 to 145 characters per vehicle and a statistical output report are:

- $30 per hour plus a purchased program package at a total cost of approximately $100,000.
- Final operations could be manual or a stand-alone computer system which would provide output data regarding each vehicle that would be forwarded to the central administrative office for processing. Programming cost for the automated system would be approximately $8,000 in addition to the above.

F.1.3 CAPITAL COSTS (OTHER)

F.1.3.1 Administrative Office Equipment

The capital costs associated with administrative office equipment (e.g.; desks, chairs, typewriters, bookcases, reference tables, etc.) is approximately $800 per person.

F.1.3.2 Quality Control Equipment

Mobile Unit - The mobile inspection audit system costs per vehicle are presented in Table F-7. The mobile inspection system could also be used for the idle-mode only to:

- Support station operation during station downtime.
- Referee activity in urban areas.

Table F-7. MOBILE UNIT COSTS PER UNIT

EQUIPMENT	COSTS
1. Van	$12,000
2. Van conversion (electrical, cabinets, etc.)	3,000
3. Analyzer (NDIR)	2,600
4. Working gas (2-blend)	100
5. Tachometer	200
6. Gravity master gas cylinders (5)	700
7. Tachometer calibrator	200
8. Hand tools	1,000
9. Digital voltmeter	200
10. Hitch	100
Total	$20,100

The calibration check will include a five-point curve check using 1 percent gravity master gases, and correlation tests using the van engine and State-owned analyzers. The State-owned analyzers will have the same capability as the station analyzers. The costs as noted were developed from a vendor survey.

Referee Stations - Customer complaints will arise regarding the reliability of emission test results, especially in cases where a vehicle fails an emission test after the recommended repairs have been performed. In order to resolve complaints of this nature, a referee station can be used. A referee station will also provide an additional check on emission test facility instrumentation, engine diagnosis, and mechanic capability. For customer convenience, as an alternate, the mobile test units could also to be used as a referee station. Upon receipt of a customer complaint and request for verification of emission test results, an appointment would be made to conduct the verification test at the test facility in question.

To avoid an overload on the system, specific criteria will have to be developed to screen complaints of possible validity for verification testing. For example, vehicles which have failed after the recommended repairs were performed and/or vehicles for which the recommended repair costs are above some predetermined level, would be eligible for verification testing.

A referee station with loaded-mode and diagnostic capabilities is the unit used in costing in this report. Figure F-3 presents such a station configuration. Correlation vehicles would be checked out at this facility. The referee station would be set up at a central area relative to the test stations. The referee station could also be the distribution center for instrumentation maintenance and parts supplies. Costs of a referee station are presented in Table F-8.

Table F-8. REFEREE FACILITY COSTS

ITEMS	MINIMUM SYSTEM (LOAD/DIAG.)
1. LAND SITE IMPROVEMENT AND BUILDING COST[a]	
Land (14,300 sq ft @ $5.97/sq ft)	$ 85,400
Site improvement (14,300 sq ft @ $1.30/sq ft)	18,600
Building construction (3,440 sq ft @ 20/sq ft)	68,800
Subtotal	$172,800
2. EQUIPMENT	
Dynamometer	$ 16,500
Driver's Aid	5,000
Analyzer bench	16,000
Gases	900
Miscellaneous-barometer, wet & dry bulb, office equipment	800
Subtotal	$ 39,200
TOTAL (1 and 2)	$212,000

[a] Location of referee facility was assumed within the major urban metropolitan areas.

Correlation Vehicle - In addition to the regularly scheduled calibration checks, correlation vehicles will be used to further standardize station-to-station equipment. An emission test performed using a highly standardized correlation vehicle will provide a quality check on the entire analytical system (i.e.,; analyzer, sample collection system, tachometer, and inspection personnel).

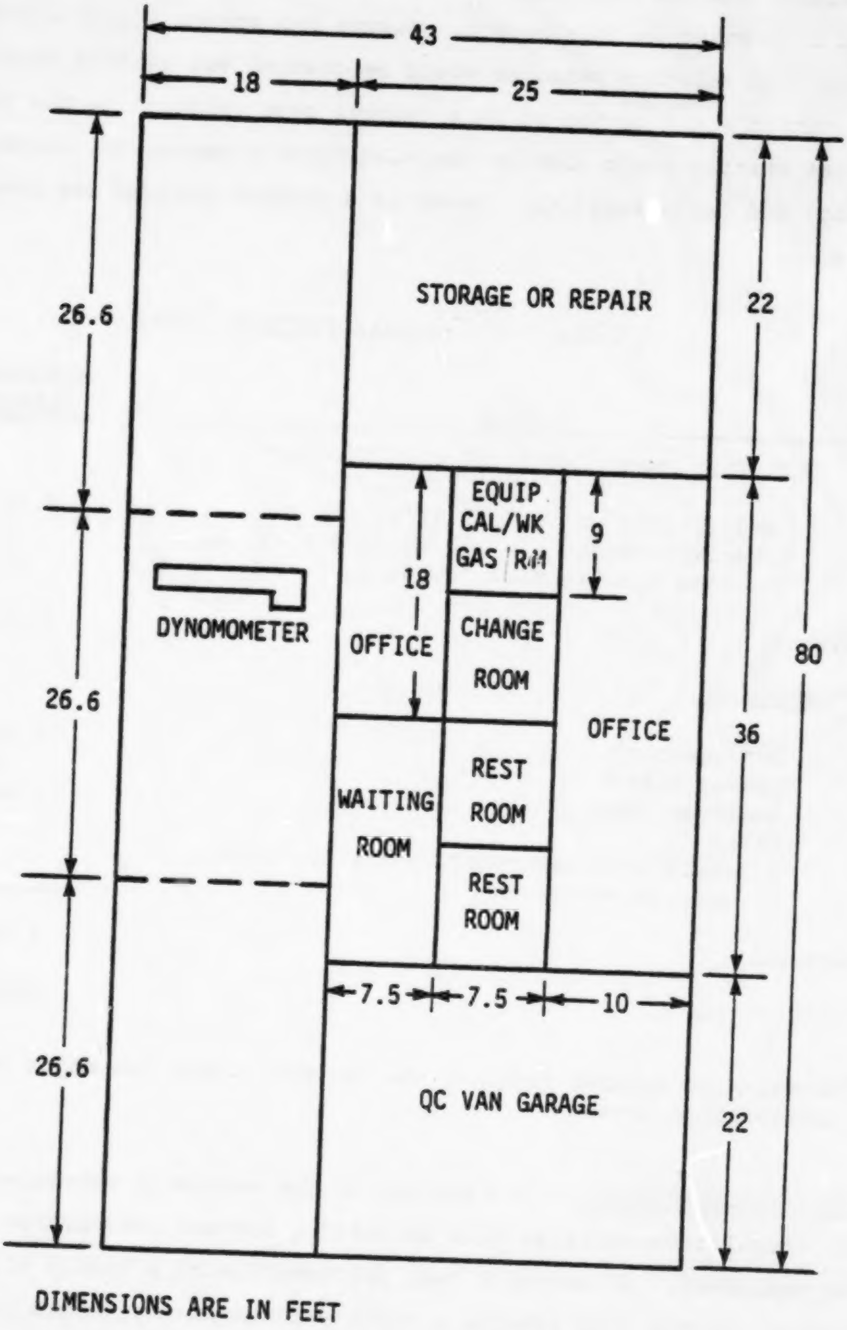

43
18
25
26.6
26.6
26.6
STORAGE OR REPAIR
22
80
EQUIP CAL/WK GAS RM
9
18
DYNOMOMETER
OFFICE
CHANGE ROOM
OFFICE
36
WAITING ROOM
REST ROOM
REST ROOM
7.5
7.5
10
QC VAN GARAGE
22
DIMENSIONS ARE IN FEET

Figure F-3. Inner Office and Test Area of a Referee Facility

The costs of a correlation vehicle are presented as follows:

CORRELATION VEHICLE COST PER UNIT

1.	Vehicle: 360 CID engine automatic transmission	$5,000.00
2.	Propane conversion (Emco)	1,000.00
3.	Take-off power items (power steering, brakes, windows, air conditioning, etc.) and remove vacuum advance and alternator	500.00
4.	Install recorder and sensing device to record fuel temperature, carburetor and engine rpm	1,500.00
5.	Install torque meter	500.00
6.	Trailer	1,200.00
	TOTAL	$9,700.00

F.1.3.3 Consumer Complaint

The consumer complaint program, as discussed in Section F.3.3 of this Appendix, requires capital investment in three (3) complaint inspection cars. Total cost would be $15,000 or $5,000 per vehicle.

F.2.1 ANNUAL OPERATING COSTS

Annual operating costs of an I/M Program include:

- Facility operating costs
- Quality control operating costs
- Support costs

They are discussed in the following subsections.

F.2.1.1 Facility Operating Costs

Primary operating costs of a facility are personnel costs and facility maintenance costs.

F.2.1.1.1 Personnel Costs

Personnel requirements and costs for 3-position, 1-lane and 3-position, 2-lane inspection facilities are presented in Table F-9 and F-10 separately. These are applicable to all emission test modes considered. In general, an inspection facility requires a manager, one inspector at each work position, and one clerk.

For the purpose of operation management, regional centers are established. These centers manage 7 to 15 inspection facilities. Extra personnel requirements for a regional center are presented in Table F-11.

F.2.1.1.2 Maintenance and Miscellaneous Costs

Facility Maintenance - Included under this program element are costs associated with electricity, heat, water, building services, insurance, office supplies, inspection forms, etc. These costs were developed from several sources including equipment and facility power requirements, equipment manufacturers, the general literature, the prevailing utility rates in the State, average heating requirements data for similar facilities, insurance costs, and general building service requirements from existing programs. The costs per facility for facility support are presented in Table F-12.

Table F-12. FACILITY SUPPLIES, UTILITIES, INSURANCE, PROPERTY TAXES, AND MAINTENANCE PER TWO-LANE FACILITY[a]

COST ITEM	STATE	CONTRACTOR
Supplies	$1,000	$ 1,000
Utilities	5,000	5,000
Insurance	1,500	1,500
Property Taxes	0	1,500
Maintenance	1,200	1,200
TOTAL	$8,700	$10,200

[a] For one-lane facility, an adjustment factor of 0.67 should be applied.

Table F-9.
PERSONNEL REQUIREMENTS AND ANNUAL COSTS FOR A ONE-LANE FACILITY

PERSONNEL CATEGORY	NUMBER REQUIRED	SALARY INCLUDING 25% BENEFIT FACTOR	TOTAL
Facility manager	1	$14,652	$14,652
Mechanical tech. II	1	13,956	13,956
Mechanical tech. I	2	12,636	25,272
Clerk I	1	12,222	12,222
Total			$66,102

Table F-10.
PERSONNEL REQUIREMENTS AND ANNUAL COSTS FOR A TWO-LANE FACILITY

PERSONNEL CATEGORY	NUMBER REQUIRED	SALARY INCLUDING 25% BENEFIT FACTOR	TOTAL
Facility manager	1	$14,652	$14,652
Mechanical tech. II	2	13,956	27,912
Mechanical techn. I	4	12,636	50,544
Clerk I	1	12,222	12,222
Total			$105,330

Table F-11.
EXTRA PERSONNEL REQUIREMENTS AND ANNUAL COSTS FOR REGIONAL CENTER

PERSONNEL CATEGORY	NUMBER REQUIRED	SALARY INCLUDING 25% BENEFIT FACTOR	TOTAL
Regional manager[a]	1	$30,680	$30,680
Clerk I	1	12,222	12,222
Total			$42,902

[a] Regional administrator would supervise approximately 7 to 15 facilities. He would be responsible for second line consumer/technician problems.

Equipment Maintenance - Annual equipment maintenance costs are presented in Table F-13. These estimates include maintenance costs for both manual and automated systems.

Table F-13. EQUIPMENT MAINTENANCE COSTS PER LANE FOR AN IDLE-MODE (EPDI TEST MODE) INSPECTION FACILITY
(Per Year)

EQUIPMENT[a]	AMOUNT
A. Manual System[b]	
Maintenance	$1,000
B. Automated System Additional Costs	
Computer maintenance	$1,350
Total automated costs	$2,350

[a] Maintenance costs are established from similar operations as 10 percent of the cost of the equipment.

[b] Loaded mode sites would be 15 percent greater for equipment maintenance.

F.2.2 SUPPORT COSTS

Costs in this category include:

- Program administration cost
- Data analysis cost
- Training cost

F.2.2.1 Administration Cost

Administration cost includes primary support in the form of manpower, supplies, and office rent.

Personnel Cost - An I/M program will be administered by a program manager who will administer the inspection program through the regional supervisors. Regional managers are assigned only to the more populous regions, with one man responsible for one or more regions or facility manager supervising 7 to 15 facilities.

The Program Administrative Office would coordinate the following functions:

- Legal activity
- Financial including purchasing, contract management (contractor only), and accounting
- Public relations and information program
- Technical reports development and reporting
- Mechanic's training
- Operations and administrative personnel training, as appropriate
- Consumer complaint activities
- Fee collection and vehicle owner notification
- Certification/licensing of mechanics

The personnel required are presented in Table F-14. The administrative personnel include the Office Manager and staff, the Quality Control Manager and staff, and the Field Manager and staff.

Supplies - Annual supplies for adminstrative personnel are estimated at $100 per person. For 15 administrative personnel the total cost is then $1,500.

Office Rent - Annual cost for rental space is $0.45 per square foot per month. The square-foot requirements per person is approximately 150 square feet at a monthly cost per person of $67.50, or a yearly cost of $810. For the 15 administrative personnel total yearly cost is estimated at $12,150.

Table F-14. ADMINISTRATIVE PERSONNEL REQUIREMENTS AND ANNUAL COSTS

PERSONNEL CATEGORY	NUMBER REQUIRED	SALARY INCLUDING 25% BENEFIT FACTOR	TOTAL
I/M Program Manager	1	$37,692	$ 37,692
Secretary (Clerk Typist III)	1	14,712	14,712
Clerk I	2	12,216	24,432
Environmental Engineer	1	23,916	23,916
Statistical Analyst	1	23,916	23,916
Quality Control Manager (Adm. 15)	1	$30,672	$ 30,672
Environmental Engineer	1	23,916	23,916
Clerk - Typist I	2	12,216	24,432
Statistical Analyst	1	23,916	23,916
Field Manager (Admin. 15)	1	$30,672	$ 30,672
Clerk - Typist I	2	12,216	24,432
Environmental Engineer	1	23,916	23,916
TOTAL	15		$306,624

F.2.2.2 Data Analysis Cost

Emission data collected will have to be reviewed and reports prepared covering various subjects as the State of Michigan may recommend. Such coverage includes:

- Repair cost and status data (current repairs, emission repairs, etc.)
- Emissions data status HC, CO, and NO_x, as appropriate
- Failure rates
- Warranty failures
- Complaint data
- Recall action
- Vehicle data
- Failure cause
- Retest status
- County status on emissions
- Operation effectiveness

From such a list it appears that monthly, quarterly, or yearly reports would involve a sizeable expense. The costs for processing 145 encoded messages for 250,000 vehicles and a simple statistical report would be approximately $1,000. To process all data associated with the above would cost in the order of $11,000 to $15,000. The associated cost to formalize the report are:

Technical layout and discussion	$50 per page
Typing and editing	$7 per page
Printing and collating	$0.10 per page

A 250-page report would cost $15,500 for preparation and publishing 50 reports. Total cost for complete quarterly reports with all noted items would be approximately $30,000 to $35,000. This could be reduced by publishing one major report with quarterly supplements. The annual cost would be approximately $45,000.

F.2.2.3 Training Cost

Personnel training is a continuing process. It is required to:

- Train new and replacement personnel
- Upgrade inspection personnel in new techniques and automotive technology changes.

The costs noted here are for continuing instruction only, and costs are estimated as \$100 per employee per year plus \$250 per year for new employee assuming a 15 percent termination rate. In equation form, this can be expressed as:

$$C_{tr} = \$100 \times Ne + \$250 \times Ne \times 15\% = \$137.5 \times Ne$$

Where:

C_{tr} = Training cost
Ne = Number of employees

F.2.3 QUALITY CONTROL OPERATING COSTS

F.2.3.1 Personnel Costs

In addition to the administrative quality control staff, the quality control section would require the field personnel complement presented in Table F-15.

The mobile unit quality control personnel requirements are necessary to provide quality control audit of each facility at least once every 3 months.

Table F-15.
QUALITY CONTROL FIELD PERSONNEL COSTS PER UNIT BASIS PER YEAR

PERSONNEL CATEGORY	NUMBER REQUIRED	SALARY INCLUDING 25% BENEFIT FACTOR	TOTAL
Mobile Control Unit (Per Unit)			
Instrument specialist	1	$13,956	$13,956
Technician I	1	12,636	12,636
Total			$26,592
Referee Station (per unit)			
Environmental engineer	1	$23,920	$23,920
Diagnostic mechanic V	1	15,418	15,418
Test technician (instrument)	1	14,586	14,586
Clerk - Steno I	1	12,220	12,220
Total			$66,144
Correlation Vehicle	No additional manpower required. This unit would be a part ot the mobile quality control audit team.		

The following methodology was used to establish mobile unit personnel requirements:

- A minimum of four facilities would be checked per day. This is based upon a 1/2-hour test time and 1-1/2 hours travel time per station.
- Each mobile unit requires one lead instrument technician and one support technician.
- The number of mobile quality control units would depend upon the number of stations required to service the vehicles for the various geographic options.
- Other functions: as a referee substitute and support in the event of a breakdown.

The quality control referee station is required to provide the following services:

- To investigate consumer complaints.
- To institute development practices to improve operation effectiveness.
- To provide a supplementary lane for overflow and support queuing problems.
- To initiate new practices related to new emission control devices.
- To provide a diagnostic routine for establishing repair effectiveness and special problem review.

The referee station number requirements was established on the basis described as follows:

- One referee station for the following service entity:

		Radius (Miles)
A.	Major Metropolitan Area	20
B.	Submetropolitan Area	30
C.	Minor Metropolitan Area	50

The correlation vehicle unit would be a part of the mobile quality control audit units. It would be used to establish correlation characteristics from station to station, and to support the quality control audit of problem stations.

Direct personnel cost for quality control can be estimated by the following equation:

Quality control personnel cost =

$$\left(\begin{array}{l}\text{mobile unit personnel}\\ \text{cost per year}\end{array}\right) \text{ x } \left(\begin{array}{l}\text{number of}\\ \text{mobile units}\end{array}\right) +$$

$$\left(\begin{array}{l}\text{Referee facility personnel}\\ \text{cost per year}\end{array}\right) \text{ x } \left(\begin{array}{l}\text{number of}\\ \text{referee facilities}\end{array}\right) =$$

$$\left(26{,}592 \text{ x } \begin{array}{l}\text{number of}\\ \text{mobile units}\end{array}\right) + 66{,}144 \text{ x } \left(\begin{array}{l}\text{number of}\\ \text{referee facilities}\end{array}\right)$$

Note that administrative quality control personnel cost is included in the administrative personnel costs.

F.2.3.2 Supply Costs

Annual supplies, C_{as}, for quality control are estimated at $100 per person. Therefore:

$$C_{as} = \$100 \times \left(\begin{array}{l}\text{mobile unit}\\ \text{personnel}\end{array}\right) + \$100 \times \left(\begin{array}{l}\text{Referee station}\\ \text{personnel}\end{array}\right) =$$

$$\$200 \times (\text{\# mobile units}) + \$400 \times (\text{\# referee stations})$$

F.2.3.3 Maintenance Costs

Mobile Units - Annual nonpersonnel costs for operation of mobile units, C_{mu}, are based upon 25,000 miles per unit at $0.15 per mile.

$$C_{mu} = 25{,}000 \times (\$0.15) \times \text{\# mobile units}) =$$
$$\$3{,}750 \times (\text{\# mobile units})$$

Referee Lanes - Annual costs for maintenance of a referee facility, C_{rf}, include:

Equipment maintenance - 5 percent of original costs, (i.e., $2,000 per year per referee station.

Building maintenance - $2,500 per year per referee station.

Thus, $C_{rf} = \$4{,}500 \times (\text{\# referee stations})$

Correlation Vehicle Maintenance Cost - Estimated maintenance cost is 10 percent of the vehicle capital cost, i.e. $1,000 per year.

Total annual cost estimates of quality control maintenance, C_{fm}, are

$$\begin{aligned}C_{fm} &= C_{mu} + C_{rf} + \$1{,}000\\ &= \$3{,}750 \times (\text{\# mobile units}) +\\ &\quad \$4{,}500 \times (\text{\# referee stations}) + \$1{,}000.\end{aligned}$$

F.3.1 COSTS OF ANCILLARY PROGRAMS

This section presents estimated start-up and operating expenditures for mechanic training, public information, and consumer complaint programs. Each program element will take advantage of existing State resources in the form of personnel services, equipment, and procedures. This will reduce the initial cost burden to institute needed consumer protection measures.

F.3.1.1 Mechanic Training

In order to develop costing data for starting a mechanic training program, it was necessary to calculate the minimum number of mechanics required to support emission repair activity.

It is estimated that 5 million vehicles will require emission testing on an annual basis. Assuming a 30 percent failure rate, 1.5 million vehicles will require some form of maintenance before reinspection. If 39 percent of all emission repairs are performed by "do-it-yourselfers" then the remaining 915,000 vehicles will be serviced by certified emission mechanics. The minimum number of mechanics required to service failed vehicles is calculated as follows:

$$\begin{aligned}\text{\# vehicles serviced/mechanic/year} &= (8 \text{ hrs/day})(1 \text{ vehicle}/1.54 \text{ hrs})\\ &\quad (5 \text{ days/wk})(50 \text{ wks/yr})\\ &= 1{,}299 \text{ vehicles}\end{aligned}$$

Assuming an 85 percent manpower efficiency, the actual number of vehicles serviced per year is calculated as 1,104 vehicles. Therefore, the estimated number of mechanics required is calculated as follows:

$$\begin{aligned}\text{\# mechanics required} &= \frac{915{,}000 \text{ vehicles/year}}{1{,}104 \text{ vehicles/mechanic/year}}\\ &= 829 \text{ mechanics}\end{aligned}$$

If the emission repair work only occupies 10 percent of the total work burden, then the minimum number of mechanics required to support the I/M program is 8,290 mechanics.

The program costs, and other relevant information, for training these mechanics are shown in Table F-16. These costs were developed by assuming that at least 30 mechanics would enroll in programs administered by State vocational instructors.

The above costs can be defrayed by charging a tuition of approximately $5 per student producing $165,800. This can be allocated to pay instructor fees, support costs (audio-visual materials).

F.3.2 PUBLIC INFORMATION PROGRAM

To estimate the costs associated with a public information program, all states with experience in I/M public information programs were contacted. From contacts and additional research, a full range of possible activities was established and basic cost figures derived (Table F-17). It is important to realize that the range of possible activities and comprehensiveness of public information programs varies considerably.

There are essentially two program elements that are widely used as I/M public information techniques. One element is the use of radio and television public service announcements, and newspaper advertisements. A second technique is the development of an information phamplet that is mailed, along with vehicle registration form to vehicle owners.

The cost to subsidize an initial and ongoing I/M public information program has been estimated at $0.25 per vehicle per year. These funds would finance various different combinations of informative programming.

Table F-16. ESTIMATED PROGRAM COSTS FOR MECHANIC TRAINING

COST CONSIDERATIONS	COSTS
A. Personnel planning, curriculum[a] development and class scheduling	$3,500.00
B. Support costs - audio visual materials[b]	200.00
C. Personnel costs: 35 instructors[c]	35,700.00[d]
Total	$39,400.00

[a] Number of classes required assuming 30 students per class is estimated 8,290 mechanics/30 per class = 277 classes.

[b] Materials estimated at $200 per course, including handouts, projection slides, charts, etc.

[c] Assuming that 1 instructor can teach 2 classes per day or 8 new classes per month (each class 19 hrs in duration), then the number of instructors required is calculated (277 classes) (1 instructor/8 classes mo.) = 35 instructors.

[d] State vocational constructors receive $13,600/yr or $6.80/hr. Each class will require 19 hrs instruction or $129/class.

Table F-17. PUBLIC INFORMATION PROGRAM COSTS FOR ONE YEAR[a]

PROGRAM TYPE	COST DESCRIPTION
A. ADVERTISEMENTS	
1. Public Service Announcements	
Newspaper	Full page advertisement 172-inch @ 1.65 per inch.
Television	1-minute public service announcements @ $40 per 10-second or $240 per minute.
Radio	1-minute service announcements @ $200 per minute includes radio and commission.
2. Pamphlet	
Development/preparation	Artist (logo and cover design) plus commission @ 20 hours.
Printing	Pamphlet printed on 20 lb paper, 1 color, foldout 7-1/2" x 11" (6 million copies).
3. Bumper Sticker	Printed on 6 lb all weather paper, 1 color.
4. Transit aids	Space cost on 35 buses, $102 per month per bus (both sides).
B. PRESENTATIONS	
1. Films	Film development (30-minute information film).
2. Slide Shows	Slide show development $500.
3. Guest Speakers	Use of existing public relations personnel minimizes cost.

[a] Telephone contacts to various advertisement agencies, publishing houses, and printers.

F.3.3 CONSUMER COMPLAINT

Two major support services provided by the consumer affairs office would involve complaint follow-up, and service industry field check. Cost estimation of these was based on California's program.

The California Air Resources Board (ARB) conducts service warranty field investigations to ensure that new and used car dealers have not tampered with the emission control devices. It is estimated that over 6,000 vehicles are checked each year prior to sale. In addition, the ARB also conduct field investigations of individual vehicle owner emission control warranty complaints, this amounts to another 250 field investigations per year. The 250 field investigations account for only a small portion of the complaints received; all of the remaining complaints are resolved over the telephone. To accomplish these tasks, the ARB has nine field investigators.

In order to estimate program costs, it was necessary to make the following additional assumptions:

- Ten percent of the vehicles that initially failed the emission test (30 percent) would fail the after-maintenance retest.

  $(0.10) \times (0.30) \times (5.3 \times 10^6) = 159{,}000$ vehicles

- Owners of those vehicles that fail the after-maintenance retest would be the most likely to file complaints; therefore, there would be 159,000 possible complaints per year.

- Based on ARB's experience, most complaints could be resolved over the telephone by field investigators. For this study, it is assumed that 90 percent would be resolved over the telephone; therefore there would be $(0.1) \times 159{,}000 = 15{,}900$ possible unresolved complaints per year.

Based on the above assumptions, it is estimated that three field investigators would be sufficient to handle the telephone-resolvable complaints and to direct the unresolved complaints to the appropriate referee stations for further investigation. Cost estimates in providing such services are presented in Table F-18.

Table F-18. OPERATING COSTS ASSOCIATED WITH CONSUMER COMPLAINT

COST CONSIDERATIONS	COSTS
Operating	
a. computer time sharing[a] 1,250 hrs @ $300 per hour	375,000
b. personnel	
3 field investigators[a]	38,000
1 statistician	10,000
3 clerks	24,000
c. vehicle	
gas/oil	3,000
insurance	1,000
TOTAL	$436,000

[a] Minimum personnel required for handling consumer complaints over the telephone and investigating.

F.3.4 VEHICLE TEST SCHEDULING

Table F-19 enumerates operating cost expenditures associated with vehicle notification, vehicle scheduling, etc. Operating costs include processing registration files, computer time, vehicle owner notification, and postage.

Table F-19. ASSUMED COST EXPENDITURES FOR VEHICLE TEST SCHEDULING

COST CONSIDERATIONS	COST
Annual Operating Expenses[a]	
Processing files 23,000 manhours x $30/hr	$ 690,000
Computer time 18 hrs x $300/hr	5,400
Notification, IBM cards 5 million cards	625,000
Postage $0.08/notification	400,000
TOTAL	$1,720,400

[a] Vehicle registration costs are included in the analysis.

F.4.1 SUMMARY

Cost data of an I/M program vary among program options. Major factors that affect costs are test mode, facility size, and operation type. Table F-20, F-21, and F-22 present a summary of cost data that were used for I/M program option cost analysis. Data in the tables are arranged by following the outline of cost elements in Table F-1.

Highlights of cost data in Table F-20, F-21, and F-22 related to program options are:

- Except for capital costs and operating costs (Items I.2 and II) of inspection facilities, cost data are essentially independent of operation types (i.e., state-operated, contractor-operated, or service center-operated).
- Administration related and quality control costs (Items I.3, II.2, and III) are the same for all program options.
- Major different cost items among test modes are capital costs (Item I.2).

Table F-20. SUMMARY OF COST DATA[a]

COST ITEMS	IDLE MODE One-Lane Facility	 Two-Lane Facility
I. **IMPLEMENTATION AND CAPITAL COSTS**		
1. Implementation Costs		
.site selection[a]	$5,000 + $400 per site	
.bids preparation and evaluation[b]	$9,300 (manual system); $14,800 (automated)	
.facility design[b]	5% of facility construction per facility	
.training plan development	$3,500	
.personnel selection	$43,000	
.document preparation	$10,000	
.administrative support	$156,000	
.system integration, checking out and certification[c]	$1,300 per facility for system integration, and checkout + $587 per lane for certification.	
.test scheduling systems development	$67,000	
2. Capital Costs[d]		
.land and site improvement		
-land	See Table F-4-Appendix F	See Table F-4-Appendix F
-site improvement	$18,600 per facility	$21,200 per facility
.facility construction	$34,800 per facility	$54,000 per facility
.instrumentation	$9,550 per lane	$9,550 per lane
.office equipment	$1,500 per facility	$1,500 per facility
.computer	0 (manual system)	
-hardware	$40,500 (automated) per lane	
-software	$100,000 (manual); $108,000 (automated)	

Table F-20. (continued)

COST ITEMS	IDLE MODE One-Lane Facility	 Two-Lane Facility
3. Capital Cost (other)		
.administrative office equipment	$12,000	
.quality control equipment		
-mobile unit	$20,100 per unit	
-referee station[e]	$212,000 per station	
-correlation car	$9,700 per car	
.consumer complaint	$15,000	
II. ANNUAL OPERATING COSTS		
1. Facility Operating Costs[f]		
.personnel[g]	$66,100 per facility in first year with 2.8% increase thereafter + $42,902 per regional center	$105,330 per facility in first year with 2.8% increase thereafter
.maintenance & miscellaneous costs		
-facility	$5,800 per facility (state-operated); $6,800 per facility (contractor-operated)	$8,700 per facility (state-operated); $10,200 per facility (contractor-operated)
-equipment	$1,000 per lane (manual) $2,350 per lane (automated)	$1,000 per lane (manual) $2,350 per lane (automated)
2. Support Costs		
.administration	$320,274	
.data analysis	$45,000	
.training	$137.5 x (number of employee)	
3. Quality Control Operating Costs		
.personnel	$26,592 x (number of mobile units) + $66,144 x (number of referee station)	
.supply	$200 x (number of mobile units) + $400 x (number of referee station)	
.maintenance	$1,000 + $3,750 x (number of mobile units) + $4,500 x (number of referee station)	

Table F-20. (continued)

COST ITEMS	IDLE MODE	
	One-Lane Facility	Two-Lane Facility
III. ANCILLARY PROGRAMS ANNUAL OPERATING COSTS		
.mechanic training	self support program	
.public information program	$0.25 per vehicle	
.consumer complaint	$451,000	
.vehicle test scheduling	$1,720,400	

[a] Unless otherwise stated, all data are applicable to state-operated, contractor-operated, and service center-operated I/M programs.

[b] For service center-operarred program, cost is 0.

[c] For service center-operated program, cost is $37.5 per center.

[d] Cost items within this group are relevant to state-operated and contractor-operated I/M programs. Only emission test instrument and accessories ($3,656) would be required for service center-operated I/M programs.

[e] Cost include $85,400 for land and $87,400 for site improvement and building construction.

[f] For service center-operated program, facility operating costs are based on $13.41 per hour (including overhead).

[g] 2.8% increase in personnel cost to account for increasing work load due to vehicle population growth.

Table F-21. SUMMARY OF COST DATA[a]

COST ITEMS	LOADED MODE	
	One-Lane Facility	Two-Lane Facility
I. IMPLEMENTATION AND CAPITAL COSTS		
1. Implementation Costs		
.site selection[b]	$5,000 + $400 per site	
.bids preparation and evaluation[b]	$13,900 (manual system); $19,400 (automated system)	
.facility design[b]	5% of facility construction per facility	
.training plan development	$5,000	
.personnel selection	$43,000	
.document preparation	$10,000	
.administrative support	$156,000	
.system integration, checking out and certification[c]	$2,100 per facility for system integration and checkout + $687 per lane for certification.	
.test scheduling systems development	$67,000	
2. Capital Costs[d]		
.land and site improvement		
-land	See Table F-4-Appendix F	See Table F-4-Appendix F
-site improvement	$18,600 per facility	$21,200 per facility
.facility construction	$39,600 per facility	$63,600 per facility
.instrumentation	$26,050 per lane	$26,050 per lane
.office equipment	$1,500 per facility	$1,500 per facility
.computer	0 (manual system)	
-hardware	$40,500 (automated) per lane	
-software	$100,000 (manual); $108,000 (automated)	

Table F-21. (continued)

COST ITEMS	LOADED MODE	
	One-Lane Facility	Two-Lane Facility
3. Capital Cost (other)		
.administrative office equipment	$12,000	
.quality control equipment		
-mobile unit	$20,100 per unit	
-referee station[e]	$212,000 per station	
-correlation car	$9,700 per car	
.consumer complaint	$15,000	
II. ANNUAL OPERATING COSTS		
1. Facility Operating Costs[f]		
.personnel[g]	$66,100 per facility in first year with 2.8% increase thereafter + $42,902 per regional center	$105,330 per facility in first year with 2.8% increase thereafter
.maintenance & miscellaneous costs		
-facility	$5,800 per facility (state-operated); $6,800 per facility (contractor-operated)	$8,700 per facility (state-operated); $10,200 per facility (contractor-operated)
-equipment	$1,500 per lane (manual) $2,750 per lane (automated)	$1,500 per lane (manual) $2,750 per lane (automated)
2. Support Costs		
.administration	$320,274	
.data analysis	$45,000	
.training	$137.5 x (number of employee)	
3. Quality Control Operating Costs		
.personnel	$26,592 x (number of mobile units) + $66,144 x (number of referee station)	
.supply	$200 x (number of mobile units) + $400 x (number of referee station)	
.maintenance	$1,000 + $3,750 x (number of mobile units) + $4,500 x (number of referee station)	

Table F-21. (continued)

COST ITEMS	LOADED MODE	
	One-Lane Facility	Two-Lane Facility
III. ANCILLARY PROGRAMS ANNUAL OPERATING COSTS		
.mechanic training	self support program	
.public information program	$0.25 per vehicle	
.consumer complaint	$451,000	
.vehicle test scheduling	$1,720,400	

[a] See note (a) in Table F-20.

[b] See note (b) in Table F-20.

[c] See note (c) in Table F-20.

[d] Instrument cost would be $20,156 for service center-operated programs. Also see note (d) in Table F-20.

[e] See note (e) in Table F-20.

[f] See note (f) in Table F-20.

[g] See note (g) in Table F-20.

Table F-22. SUMMARY OF COST DATA[a]

COST ITEMS	EPDI TEST MODE	
	One-Lane Facility	Two-Lane Facility
I. IMPLEMENTATION AND CAPITAL COSTS		
1. Implementation Costs		
.site selection[b]	$5,000 + $400 per site	
.bids preparation and evaluation[b]	$9,300 (manual system); $14,800 (automated system)	
.facility design[b]	5% of facility construction per facility	
.training plan development	$7,500	
.personnel selection	$43,000	
.document preparation	$10,000	
.administrative support	$156,000	
.system integration, checking out and certification[c]	$1,100 per facility for system integration and checkout + $587 per lane for certification.	
.test scheduling systems development	$67,000	
2. Capital Costs[d]		
.land and site improvement		
-land	See Table F-4-Appendix F	See Table F-4-Appendix F
-site improvement	$18,600 per facility	$21,200 per facility
.facility construction	$34,800 per facility	$54,000 per facility
.instrumentation	$15,550 per lane	$15,550 per lane
.office equipment	$1,500 per facility	$1,500 per facility
.computer	0 (manual system)	
-hardware	$40,500 (automated) per lane	
-software	$100,000 (manual); $108,000 (automated)	

Table F-22. (continued)

COST ITEMS	EPDI TEST MODE One-Lane Facility	 Two-Lane Facility
3. Capital Cost (other)		
.administrative office equipment	$12,000	
.quality control equipment		
-mobile unit	$20,100 per unit	
-referee station[e]	$212,000 per station	
-correlation car	$9,700 per car	
.consumer complaint	$15,000	
II. ANNUAL OPERATING COSTS		
1. Facility Operating Costs[f]		
.personnel[g]	$66,100 per facility in first year with 2.8% increase thereafter + $42,902 per regional center	$105,330 per facility in first year with 2.8% increase thereafter
.maintenance & miscellaneous costs		
-facility	$5,800 per facility (state-operated); $6,800 per facility (contractor-operated)	$8,700 per facility (state-operated); $10,200 per facility (contractor-operated)
-equipment	$1,000 per lane (manual) $2,350 per lane (automated)	$1,000 per lane (manual) $2,350 per lane (automated)
2. Support Costs		
.administration	$320,274	
.data analysis	$45,000	
.training	$137.5 x (number of employee)	
3. Quality Control Operating Costs		
.personnel	$26,592 x (number of mobile units) + $66,144 x (number of referee station)	
.supply	$200 x (number of mobile units) + $400 x (number of referee station)	
.maintenance	$1,000 + $3,750 x (number of mobile units) + $4,500 x (number of referee station)	

Table F-22. (continued)

COST ITEMS	EPDI TEST MODE	
	One-Lane Facility	Two-Lane Facility
III. ANCILLARY PROGRAMS ANNUAL OPERATING COSTS		
.mechanic training	self support program	
.public information program	$0.25 per vehicle	
.consumer complaint	$451,000	
.vehicle test scheduling	$1,720,400	

[a] See note (a) in Table F-20.

[b] See note (b) in Table F-20.

[c] See note (c) in Table F-20.

[d] Instrument cost would be $8,000 for service center-operated programs. Also see note (d) in Table F-20.

[e] See note (e) in Table F-20.

[f] See note (f) in Table F-20.

[g] See note (g) in Table F-20.

Appendix G

DETAILED TEST LANE REQUIREMENTS BY TEST MODE

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LDV IDLE TEST LANE REQUIREMENTS
YEAR - 1983

COUNTY	NUMBER OF LANES Statewide	Nonattainment Counties	Grand Rapids	Lansing	Flint	Detroit
Alcona	.24					
Alger	.21					
Allegan	1.78	1.78				
Alpena	.80					
Antrim	.40					
Arenac	.31					
Baraga	.19					
Barry	.98	.98				
Bay	3.05	3.05				
Benzie	.27					
Berrien	4.47	4.47				
Branch	.97	.97				
Calhoun	3.70	3.70				
Cass	1.17	1.17				
Charlevoix	.50					
Cheboygan	.50					
Chippewa	.74					
Clare	.52					
Clinton	1.27	1.27		1.27		
Crawford	.23					
Delta	.92					
Dickinson	.66					
Eaton	1.91	1.91		1.91		
Emmet	.58					
Genesee	11.61	11.61			11.61	
Gladwin	.41					
Gogebic	.45					
Grand Traverse	1.44					
Gratiot	.95	.95				
Hillsdale	.98	.98				
Houghton	.75					
Huron	.92	.92				
Ingham	6.74	6.74		6.74		
Ionia	1.08	1.08				
Iosco	.70					
Iron	.35					
Isabella	.96					
Jackson	3.72	3.72				
Kalamazoo	5.39	5.39				
Kalkaska	.24					
Kent	11.75	11.75	11.75			
Keweenaw	.06					
Lake	.17					

(continued)

LDV IDLE TEST LANE REQUIREMENTS (Continued)
YEAR - 1983

	NUMBER OF LANES					
COUNTY	Statewide	Nonattainment Counties	Grand Rapids	Lansing	Flint	Detroit
Lapeer	1.42	1.42				
Leelanau	.33					
Lenawee	2.18	2.18				
Livingston	2.05	2.05				
Luce	.15					
Mackinac	.23					
Macomb	19.68	19.68				19.68
Manistee	.56					
Marquette	1.61	1.61				
Mason	.62					
Mecosta	.62					
Menominee	.63					
Midland	1.87	1.87				
Missaukee	.21					
Monroe	3.19	3.19				3.19
Montcalm	1.07	1.07				
Montmorency	.19					
Muskegon	3.99	3.99				
Newaygo	.75					
Oakland	28.71	28.71				28.71
Oceana	.47					
Ogemaw	.38					
Ontonagon	.25					
Osceola	.41					
Oscoda	.16					
Otsego	.35					
Ottawa	3.77	3.77	3.77			
Presque Isle	.34					
Roscommon	.42					
Saginaw	5.84	5.84				
St. Clair	3.32	3.32				
St. Joseph	1.36	1.36				
Sanilac	.93	.93				
Schoolcraft	.22					
Shiawassee	1.66	1.66				
Tuscola	1.25	1.25				
Van Buren	1.52	1.52				
Washtenaw	6.41	6.41				6.41
Wayne	61.74	61.74				61.74
Wexford	.60					
Foreign	.80					
Total	237.30	216.01	15.52	9.92	11.61	119.73

LDV LOADED TEST LANE REQUIREMENTS
YEAR - 1983

COUNTY	NUMBER OF LANES Statewide	Nonattainment Counties	Grand Rapids	Lansing	Flint	Detroit
Alcona	.29					
Alger	.25					
Allegan	2.13	2.13				
Alpena	.95					
Antrim	.48					
Arenac	.37					
Baraga	.22					
Barry	1.88	1.88				
Bay	3.65	3.65				
Benzie	.33					
Berrien	5.36	5.36				
Branch	1.16	1.16				
Calhoun	4.43	4.43				
Cass	1.40	1.40				
Charlevoix	.60					
Cheboygan	.60					
Chippewa	.89					
Clare	.62					
Clinton	1.53	1.53		1.53		
Crawford	.27					
Delta	1.10					
Dickinson	.79					
Eaton	2.29	2.29		2.29		
Emmet	.70					
Genesee	13.91	13.91			13.91	
Gladwin	.49					
Gogebic	.54					
Grand Traverse	1.73					
Gratiot	1.13	1.13				
Hillsdale	1.17	1.17				
Houghton	.90					
Huron	1.10	1.10				
Ingham	8.08	8.08		8.08		
Ionia	1.30	1.30				
Iosco	.83					
Iron	.42					
Isabella	1.15					
Jackson	4.45	4.45				
Kalamazoo	6.46	6.46				
Kalkaska	.29					
Kent	14.08	14.08	14.08			
Keweenaw	.07					
Lake	.20					

(continued)

LDV LOADED TEST LANE REQUIREMENTS (Continued)
YEAR - 1983

	NUMBER OF LANES					
COUNTY	Statewide	Nonattainment Counties	Grand Rapids	Lansing	Flint	Detroit
Lapeer	1.70	1.70				
Leelanau	.40					
Lenawee	2.61	2.61				
Livingston	2.46	2.46				
Luce	.17					
Mackinac	.27					
Macomb	23.57	23.57				23.57
Manistee	.67					
Marquette	1.92	1.92				
Mason	.75					
Mecosta	.75					
Menominee	.75					
Midland	2.24	2.24				
Missaukee	.25					
Monroe	3.82	3.82				3.82
Montcalm	1.28	1.28				
Montmorency	.22					
Muskegon	4.78	4.78				
Newaygo	.90					
Oakland	34.39	34.39				34.39
Oceana	.56					
Ogemaw	.45					
Ontonagon	.30					
Osceola	.49					
Oscoda	.19					
Otsego	.42					
Ottawa	4.52	4.52	4.52			
Preseque Isle	.41					
Roscommon	.51					
Saginaw	7.00	7.00				
St. Clair	3.98	3.98				
St. Joseph	1.63	1.63				
Sanilac	1.12	1.12				
Schoolcraft	.26					
Shiawassee	1.98	1.98				
Tuscola	1.50	1.50				
Van Buren	1.82	1.82				
Washtenaw	7.68	7.68				7.68
Wayne	73.96	73.96				73.96
Wexford	.72					
Foreign	.96					
Total	284.25	258.77	18.60	11.90	13.91	143.42

LDV EPDI TEST LANE REQUIREMENTS
YEAR - 1983

COUNTY	MOTOR VEHICLE POPULATION					
	Statewide	Nonattainment Counties	Grand Rapids	Lansing	Flint	Detroit
Alcona	1.24					
Alger	1.06					
Allegan	9.08	9.08				
Alpena	4.06					
Antrim	2.06					
Arenac	1.58					
Baraga	.96					
Barry	5.02	5.02				
Bay	15.58	15.58				
Benzie	1.4					
Berrien	22.86	22.86				
Branch	4.96	4.96				
Calhoun	18.92	18.92				
Cass	5.98	5.98				
Charlevoix	2.56					
Cheboygan	2.54					
Chippewa	3.8					
Clare	2.64					
Clinton	6.5	6.5		6.5		
Crawford	1.16					
Delta	4.72					
Dickinson	3.38					
Eaton	9.78	9.78		9.78		
Emmet	2.98					
Genesee	59.36	59.36			59.36	
Gladwin	2.08					
Gogebic	2.30					
Grand Traverse	7.36					
Gratiot	4.84	4.84				
Hillsdale	5.02	5.02				
Houghton	3.82					
Huron	4.68	4.68				
Ingham	34.48	34.48		34.48		
Ionia	5.54	5.54				
Iosco	3.56					
Iron	1.78					
Isabella	4.92					
Jackson	19	19				
Kalamazoo	27.54	27.54				
Kalkaska	1.24					
Kent	60.06	60.06	60.06			
Keweenaw	.28					
Lake	.86					

LDV EPDI TEST LANE REQUIREMENTS (Continued)
YEAR - 1983

COUNTY	MOTOR VEHICLE POPULATION Statewide	Nonattainment Counties	Grand Rapids	Lansing	Flint	Detroit
Lapeer	7.26	7.26				
Leelanau	1.70					
Lenawee	11.14	11.14				
Livingston	10.5	10.5				
Luce	.74					
Mackinac	1.16					
Macomb	100.56	100.56				100.56
Manistee	2.86					
Marquette	8.22	8.22				
Mason	3.18					
Mecosta	3.18					
Menominee	3.22					
Midland	9.54	9.54				
Missaukee	1.08					
Monroe	16.28	16.28				16.28
Montcalm	5.44	5.44				
Montmorency	.94					
Muskegon	20.38	20.38				
Newaygo	3.86					
Oakland	146.72	146.72				146.72
Oceana	2.4					
Ogemaw	1.94					
Ontonagon	1.26					
Osceola	2.10					
Oscoda	.82					
Otsego	1.80					
Ottawa	19.26	19.26	19.26			
Presque Isle	1.74					
Roscommon	2.16					
Saginaw	29.86	29.86				
St. Clair	16.94	16.94				
St. Joseph	6.94	6.94				
Sanilac	4.76	4.76				
Schoolcraft	1.12					
Shiawassee	8.46	8.46				
Tuscola	6.4	6.4				
Van Buren	7.76	7.76				
Washtenaw	32.76	32.76				32.76
Wayne	315.56	315.56				315.56
Wexford	3.06					
Foreign	4.08					
Total	1,212.68	1,130.94	79.32	50.76	59.36	611.88